MAKING MATHEMATICS WORK

NELSON and GRIME

RIVERSIDE·MATHEMATICS·SERIES

MAKING

MATHEMATICS

WORK

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Assisted by F. N. Burroughs

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UNIT ONE

Problem-Solving Skills

CHAPTER 1

BOSTON HERALD-TRAVELER

Without a theory, a plan,
the mere mechanical manipulation
of the numbers in a problem
does not necessarily make sense
just because you are
using Arithmetic!

H. G. and L. R. Lieber, *The Education of T. C. Mits.* W. W. Norton, 1944

ANALYZING PROBLEMS

WHENEVER AN INTELLIGENT PERSON begins the study of a new subject, he quite naturally asks: "What will I learn from this subject? What good will it do me?" This course will be worth while because in it you will learn how to solve the kinds of problems that arise in actual day-by-day living.

Whether you work in an office, a factory, or a store, on a farm or at home, situations will arise in which a knowledge of budgeting, installment buying, insurance, and banking will be of value to you. You will also need to know how to plan trips and compute their cost, how to send goods and money from one place to another, and, in general, how to make the best use of the different methods of travel and means of communication.

Solving the problems of everyday life is more than a matter of luck. Certain specific skills are required. You must be able to decide what you are looking for, what facts you have with which to work, and what computations you must make. You should be able to estimate the answer, so that you will have a general idea of what to expect.

Try-Out Test on Solving Problems

A "try-out test" begins on the next page. Its purpose is to help you analyze your own problem-solving skills. Like most people, you will probably be strong in some and weaker in others. Your job will be to strengthen yourself in the skills in which you are weak.

Do not work out the answers to these problems. Instead select all the correct statements from the list that follows each problem. Remember that there may be one or more than one correct statement in a list.

Can You Tell What You Are to Find?

1. William has 18 customers for the daily paper. He collects 42 cents each week from each customer. Find the total amount he collects each week.

In solving this problem, I am to find: (*a*) how many customers William has; (*b*) how many papers he delivers in a week; (*c*) how much money William collects from his customers in a week; (*d*) how much money he collects from each customer each week.

2. Mary's allowance is $4.25 a week. Every school day she spends 45 cents for lunch. One week, in addition to paying for her lunches, she spent 55 cents for a notebook and 35 cents for a movie, and saved the remainder. How much did she save?

This problem asks me to find: (*a*) how much money Mary spent in a week; (*b*) Mary's allowance per week; (*c*) how much Mary had left at the end of the week; (*d*) the cost of Mary's lunches for one week.

Do You Know What a Problem Tells You?

3. Homer Anderson's salary is $3600 a year. He saves 15 per cent of this amount. How much does he save in a month?

This problem tells me that: (*a*) Mr. Anderson spends 15 per cent of his salary; (*b*) Mr. Anderson earns $3600 a year; (*c*) Mr. Anderson saves 15 per cent of his salary.

4. Mrs. Green bought 15 quarts of berries at $.47 a quart and $.67 worth of sugar. How much change should she have received from a ten-dollar bill?

The facts I have to work with are: (*a*) Mrs. Green handed the clerk a five-dollar bill; (*b*) the cost of the sugar was 67 cents; (*c*) the berries cost 47 cents a quart; (*d*) Mrs. Green bought 47 quarts of berries; (*e*) Mrs. Green bought 67 pounds of sugar.

5. The cost price of a Series E United States Savings Bond is 75 per cent of the maturity value, i.e., of the stated or face value. Mr. Scott wishes to buy a bond whose maturity value is $500. How much will the bond cost?

This problem tells me that: (*a*) the cost price of the bond

Mr. Scott wishes to buy is $500; (*b*) the maturity value of a Series E United States Savings Bond is 75 per cent of the cost price; (*c*) the maturity value of the bond Mr. Scott wishes to buy is $500.

Can You Tell What Facts You Need to Solve a Problem?

6. Thomas Goodwin works in a grocery store every afternoon after school and all day on Saturday. On school days he begins work at 4:00 P.M. and on Saturday at 9:00 A.M. He works 2 hours each school day and 8 hours on Saturday. He is paid 75 cents an hour. How much does Thomas earn in a week?

The facts I must use to find the answer to this problem are: (*a*) the time Thomas begins work on school days; (*b*) the time he begins work on Saturday; (*c*) the number of hours he works each school day; (*d*) the number of hours he works on Saturday; (*e*) the amount he earns per hour.

7. Mr. Mason spends 20 per cent of his monthly income for rent and 25 per cent for food. His annual income is $5,000. How much does he spend for food each month?

The facts needed to solve this problem are: (*a*) the amount of Mr. Mason's annual income; (*b*) the per cent of his monthly income spent for rent; (*c*) the per cent of his monthly income spent for food.

8. Mr. Martin is planning to paint his house. He figures that he will need 15 gallons of paint. He can buy a five-gallon can of paint for $27.75. The same paint in one-gallon cans costs $5.85 a gallon. How much less per gallon does the paint cost if bought in five-gallon cans?

The facts needed to solve this problem are: (*a*) the number of gallons of paint Mr. Martin will need; (*b*) the cost of a five-gallon can of paint; (*c*) the cost of a gallon of paint if bought in a one-gallon can.

Can You Tell What Facts Are Not Important?

9. Mr. and Mrs. Patten and their two children, Jane, age 16, and Robert, age 14, live in Austin, Texas. They plan to visit Mrs. Patten's mother who lives in Oklahoma. Which will cost less, to go by train or to drive their own car?

In solving this problem, the *least* important fact to consider is: (*a*) the train schedule; (*b*) the number of persons making the trip; (*c*) the train fare for each person; (*d*) the cost per mile of driving the car.

10. On February 1, Walter Hale borrowed some money from a bank. The loan was to be repaid in 60 days with interest. Mr. Hale wanted to calculate how much he would owe the bank at the end of 60 days.

In solving this problem, the *least* important fact to consider is: (*a*) the amount of money borrowed; (*b*) the rate of interest; (*c*) the length of time Mr. Hale had the money; (*d*) the date the loan was made.

Do You Know What Arithmetic Processes to Use?

11. Steve has $17.45 in a savings account at the bank. If he deposits $2.25 in his account this month, what will his new balance be?

The process that should be used in solving this problem is: (*a*) addition; (*b*) subtraction; (*c*) multiplication; (*d*) division.

12. Mr. Clark borrowed $56.40. He repaid the loan, plus interest, in 12 monthly payments of $5.00 each. The difference between the amount borrowed and the amount paid back is the interest on the loan. How much interest did Mr. Clark pay?

The first process to use in solving this problem is: (*a*) addition; (*b*) subtraction; (*c*) multiplication; (*d*) division.

The next process to use is: (*e*) addition; (*f*) subtraction; (*g*) multiplication; (*h*) division.

13. Susan Bryant, whose home is in Denver, is planning to visit friends in Dallas. The bus fare from Denver to Dallas is $23.97. A round-trip ticket may be purchased for $43.18. How much can Susan save by buying a round-trip ticket rather than two one-way tickets?

The first process that should be used in solving this problem is: (*a*) addition; (*b*) subtraction; (*c*) multiplication; (*d*) division.

The second process that should be used is: (*e*) addition; (*f*) subtraction; (*g*) multiplication; (*h*) division.

Can You Tell What to Do to Find the Answer?

14. Four boys, all high-school seniors, agreed to share expenses on a camping trip. They spent \$12.40 for food, and they used 15 gallons of gasoline, costing 28 cents a gallon, for the car. What was each boy's share of the expenses?

The correct method of finding the answer to this problem is:

(*a*)
$$\$12.40 \div 4 = \$3.10$$
$$15 \times \$.28 = \$4.20$$
$$\$3.10 + \$4.20 = \text{Answer}$$

(*b*)
$$15 \times \$.28 = \$4.20$$
$$\$12.40 + \$4.20 = \$16.60$$
$$\$16.60 \div 4 = \text{Answer}$$

(*c*)
$$15 + 28 = 43$$
$$\$12.40 + \$.43 = \$12.83$$
$$\$12.83 \div 4 = \text{Answer}$$

(*d*)
$$15 \times \$.28 = \$4.20$$
$$\$4.20 \div 4 = \$1.05$$
$$\$12.40 + \$1.05 = \text{Answer}$$

15. Mr. Jamison bought a television set for \$269.50. A down payment of \$59.50 was required, and the amount unpaid was divided into four equal monthly payments. What was the amount of each monthly payment?

To find the answer to this problem, I would: (*a*) subtract \$59.50 from \$269.50 and multiply the result by 4; (*b*) add \$59.50 to \$269.50 and divide the sum by 4; (*c*) subtract \$59.50 from \$269.50 and divide the result by 4; (*d*) divide \$269.50 by 4 and subtract \$59.50 from the answer.

16. Mr. Cowley estimates that it costs him 5 cents a mile to operate his automobile, and that he drives it 700 miles a month. His income is \$250 a month. What per cent of his income does he spend on his automobile?

To solve this problem I would: (*a*) divide 700 by 5, divide the result by 250, and change the quotient to a per cent: (*b*) multiply 5 cents by 700, divide the product by \$250, and change the result to a per cent; (*c*) multiply 5 cents by 700 and divide the product by \$250; (*d*) multiply 5 cents by 700, divide the product by \$250, and place a per cent sign after the quotient.

How Good Are You at Estimating Answers?

17. The girls in Miss Cameron's sewing class are planning to make four costumes for an operetta. They will need $2\frac{1}{2}$ yards of material for one costume, $3\frac{1}{4}$ yards for the second, $3\frac{3}{4}$ yards for the third, and $2\frac{1}{4}$ yards for the fourth. How much will the material cost at 50 cents a yard?

From this information I know that the cost of the material will be: (*a*) about \$20; (*b*) a little less than \$12; (*c*) between \$2 and \$4; (*d*) between \$5 and \$6.

18. Judy works as a saleslady in a five-and-ten-cent store every afternoon after school. She gets out of school at 3:00 P.M. and starts work as soon as she can get to the store. She must start work not later than 3:30 P.M. The store closes at 6:00 P.M. Judy gets paid 80 cents an hour.

The information given tells me that each afternoon Judy earns: (*a*) a little less than \$2; (*b*) at least \$2; (*c*) between 75 cents and \$1.50; (*d*) about \$5.

19. Robert Jensen is paid \$1 an hour for working 40 hours a week. All time over 40 hours is considered overtime. Robert is paid \$1.50 an hour for overtime. Last week he worked 48 hours. How much did he earn last week?

I estimate the answer as: (*a*) \$45; (*b*) \$50; (*c*) \$70; (*d*) \$75.

20. Charles Taylor bought a suit of clothes for \$39.95. The state in which he lives collects a 3 per cent sales tax on such purchases. How much sales tax was Charles required to pay on this purchase?

My estimate of the answer is: (*a*) \$.80; (*b*) \$.12; (*c*) \$12.00; (*d*) \$1.20.

How do you rate?	Excellent	Good	Fair	Poor
	19–20	17–18	14–16	13 or less

This chart tells your rating according to the number of problems you answered correctly. A similar chart appears at the end of each test in this book.

How to Attack Problems

When you have a problem to solve, first get the problem clearly in mind. Decide just what the problem asks you to find and what it tells you. Then you can decide what processes to use, and what figures to add, subtract, multiply, or divide.

Deciding What a Problem Asks

Example: One Saturday Jean worked at a neighborhood grocery from 9:15 A.M. to 5:15 P.M. with half an hour off for lunch. She was paid $.75 an hour. What were her earnings for the day?

This problem asks you to find the amount of money that Jean earned on a certain day.

PRACTICE

Tell in your own words what each of the following problems asks you to find:

1. An electric iron is marked $13.95. At a sale it is offered at a discount of 15 per cent. How much would you pay if you bought it at the sale?

2. Before starting on an automobile trip, Mr. White measured his route on a road map. The distance was $5\frac{1}{2}$ inches. The scale of the map was 1 inch to 80 miles. How many miles was the distance Mr. White planned to travel?

3. Martha Arnold is planning to buy ice cream for a picnic. She can buy 5 gallons for $13.50 or she can buy ice cream of the same quality at 75 cents a quart. How much will she save by buying the 5 gallons for $13.50 instead of by the quart?

4. Mr. Parker's car averages 15 miles per gallon of gasoline. The gasoline tax in the state in which he lives is 4 cents a gallon. How much gasoline tax does Mr. Parker have to pay on the gasoline he uses in a year when he drives 8250 miles?

5. Mrs. Williams bought an electric washer for $139.50. She paid $39.50 in cash and agreed to pay the balance at $5.00 a week. How many weeks will it take her to pay the balance?

In out-of-school life as well as in school, problem-solving requires an understanding of the available facts.

Recognizing What a Problem Tells You

Example: The girls in a cooking class are going to make 20 pints of ice cream. The recipe they intend to use calls for $\frac{1}{2}$ pint of heavy cream for each quart of ice cream. How many pints of heavy cream will be needed?

This problem tells you:

(1) The girls intend to make 20 pints of ice cream
(2) Each *quart* of ice cream requires $\frac{1}{2}$ pint of heavy cream

PRACTICE

Tell in your own words what information you can use to solve each of the following problems:

1. Mr. Brown owns a house and lot assessed at $4500. The tax rate is $12.50 per $1000. How much is Mr. Brown's tax?

2. Mrs. Baylor has saved $400 to buy new furniture for her home. She would like to buy a davenport priced at $89.50, a bedroom set for $127.50, a rug for $68.95, and a table for $97.50. Will the $400 she has saved pay for all this furniture?

3. Mr. Andrews has a $5000 life insurance policy on which he pays $31.56 a year for each $1000 of insurance. How much does he pay per year on this policy?

4. A coal company charges $.25 a ton on bills not paid within 30 days from the date of purchase. Mr. Davis always delays the payment of his coal bills until after the 30-day limit. He purchased 9 tons of coal last year. How much might he have saved by paying his bills within the 30-day limit?

5. Mr. Wheland plans to make an automobile trip of 850 miles. He knows that his car makes 17 miles on a gallon of gasoline. The gasoline for the trip will cost 30 cents a gallon. What will be the cost of the gasoline for the trip?

Deciding What Processes to Use

Example: Leroy earns $8.25 a week on his paper route. He spends $4.50 a week and saves the rest. In how many weeks can he save enough to pay for a bicycle priced at $48.75?

The process to use first is subtraction: $8.25 − $4.50 = $3.75
The process to use next is division: $48.75 ÷ $3.75 = Answer

PRACTICE

Tell, in the correct order, the processes you would use to solve each of the following problems:

1. A radio is offered for $94.50 cash or for $5 down and $8.25 a month for 12 months. How much is saved by buying the radio for cash rather than on the time-payment plan?

2. On January 1, 1954, the House of Representatives of the United States consisted of 435 members. One member was an Independent, 213 were Democrats, and the others were Republicans. How many Republican members were there?

3. When Mr. Masten started on an automobile trip the speedometer on his car read 26,746.5 miles. At the end of the trip it read 27,962.5 miles. Mr. Masten found that he had used 76 gallons of gasoline on the trip. Find the average number of miles per gallon he made on the trip.

4. James Baker bought a United States Savings Bond for \$37.50. When it matures its value will have increased to \$50. What fraction of the cost is the increase in value?

5. A recipe calls for $1\frac{3}{4}$ pounds of sugar. Sally is making four times the recipe. How much will the sugar cost at 11 cents a pound?

Selecting the Figures to Use

Example: Gerald works 2 hours a day for 5 days a week and 6 hours on Saturday. He is paid \$.80 an hour. How much does he earn in a week?

The first thing to do is to multiply 2 by 5: $2 \times 5 = 10$
The next step is to add 6 to the product: $6 + 10 = 16$
The third step is to multiply \$.80 by the sum: $16 \times \$.80 = \$12.80$ Answer

PRACTICE

Tell exactly what to do to find the correct answer to each of the following problems:

1. When Mr. Pearce left home on a trip, the speedometer on his car read 5462 miles. When he returned it read 5830 miles. He used 23 gallons of gasoline on the trip. How many miles did he average on a gallon of gasoline?

2. Roy earns \$4.75 delivering newspapers and \$1.65 a week selling magazines. He saves one half of his earnings. How many weeks will it take him to save enough to pay cash for a bicycle priced at \$52.50?

3. Five boys went on a camping trip for 2 weeks. Their food for the 2 weeks cost them \$74.85. They rented a cottage at \$25 a week and a boat at \$6.50 a week. The expenses were divided evenly among the boys. How much was each boy's share?

4. Mr. Arthur purchased a used car for \$1325. He paid \$650 in cash and agreed to pay the balance at the rate of \$75 a month. How many monthly payments was Mr. Arthur required to make?

5. The pupils in Miss Hart's homeroom are planning to make 12 curtains for the windows in their room. They figure

that each curtain will take 60 inches of material which costs \$1.49 a yard. How much will the material for all the curtains cost?

Reading Problems Carefully

If you read carefully and thoughtfully, you can often analyze a problem very well the first time you read it. You can decide what it asks you, what it tells you, and what you must do to solve it. In addition, you should notice whether any facts you need are missing. And you should guard against being confused when you are given more facts than are really necessary.

Taking Several Steps at Once

Example: During the summer, Joe Jackson works 38 hours a week as a gasoline-station attendant at \$1.30 an hour. How much does he earn in a week?

What does this problem ask you to find?

Joe's weekly earnings

What does this problem tell you?

(1) Joe works 38 hours a week

(2) Joe earns \$1.30 an hour

What must you do to get the correct answer?

Multiply \$1.30 by 38

PRACTICE

Read each of these problems once; then see whether you can answer the questions that follow it:

1. Charlotte bought a hat for \$3.98 and a dress for \$8.75. What was the cost of both?

a. What does this problem ask you to find?

b. How much did Charlotte pay for the hat?

c. How much did she pay for the dress?

d. What must you do to get the correct answer?

2. A truck loaded with coal weighed 5275 pounds. The truck when empty weighed 2195 pounds. What was the weight of the coal?

a. What does this problem ask you to find?

b. What was the weight of the truck loaded with coal?

c. What did the truck weigh when empty?

d. What must you do to find the correct answer?

3. Mr. Adams earned $72.15 (before deductions) for a week's work. He is paid $1.85 an hour. How many hours did he work that week?

a. What does this problem ask you to find?

b. How much money did Mr. Adams earn?

c. How much is he paid an hour?

d. What must you do to find the correct answer?

4. Mary Woods makes $6.75 a week working as a clerk in a department store after school and on Saturdays. Last week she spent $1.45 for school lunches, 50 cents for a street car pass, and $1.89 for a gift for her mother. She saved the remainder of her earnings. How much did she save?

a. What does this problem ask you to find?

b. How much does Mary earn in a week?

c. What did she spend her money for last week?

d. What must you do to find the correct answer?

5. Mrs. Hudson plans to spend an average of not more than $24.00 a week for food for her family. Last month she spent $21.79 the first week, $22.54 the second week, $21.78 the third week, and $23.13 the fourth week. What was the average amount spent for food per week last month?

a. What does this problem ask you to find?

b. How much did Mrs. Hudson spend for food each of the four weeks?

c. What must you do to find the correct answer?

Recognizing When Facts Are Missing

Example: The regular price of a radio is $69.95. At a sale it is offered at a discount. What is the sale price of the radio?

The fact that is missing is the rate of the discount.

PRACTICE

Tell what fact is missing in each of the following problems:

1. Roberta deposited $5.35 in her savings account last month and $3.75 this month. How much money does she have in her savings account now?

2. Mrs. Jones bought a four-pound roast and ten pounds of potatoes. How much change should she have received from a ten-dollar bill?

3. George is planning to buy a used bicycle to be used in delivering telegrams. He can buy one for $34.75 in cash or for $5 in cash and $4.50 a month. How much can he save by paying cash for the bicycle?

4. Last year Mr. Allen drove his car 8570 miles. How much did his gasoline for the year cost at 29 cents a gallon?

5. At a special sale, the Robertson Furniture Company sold various pieces of furniture at reductions of 20 per cent to 35 per cent. What would have been the cost, during the sale, of a television set that previously had sold for $475?

Knowing When a Fact Is Not Needed

Example: Florence Barton is planning a trip by train to San Antonio. She has learned that a train leaves her home town at 8:37 A.M. and arrives in San Antonio at 11:59 A.M. The distance is 173 miles and the fare is $6.71 including tax. How long will the trip take?

The facts you need are the time the train leaves and the time it arrives.

The facts you do not need to solve the problem are the distance and the fare.

PRACTICE

Select the facts that are needed to find the answers to the following:

1. John would like to buy a radio that costs $22.75. He earns $3.50 a week working in a grocery store. If he saves one fourth of his earnings how much will he save in 24 weeks?

2. During the summer Stanley Foote worked on a farm. He worked 8 hours a day, 6 days a week for 12 weeks. He was paid $500 for his summer's work. He saved 50 per cent of his earnings and spent the rest. How much did he save?

3. In a test having 25 problems, Marian had 21 problems worked correctly. The average of the class was 17 correct. What per cent of the problems did Marian have correct?

4. After spending $4.84 for meat, Mrs. Willard found that she had $11.16 of her weekly food allowance left. She then bought $3.79 worth of fruit and $4.75 worth of vegetables. How much of her food allowance remained?

5. On August 21, 1953 a Marine Corps test pilot in a jet plane set a new altitude record. The jet plane was carried aloft by a B-29 and released at 34,000 feet above sea level. Then using rocket power it reached a height of 82,235 feet. How many miles above sea level did this jet plane reach?

How to Estimate Answers

Before doing the actual computations in solving a problem, it is a good plan to estimate the answer. You will then know approximately what your answer should be. If you find that your answer differs a great deal from your estimated answer, you will know that you have made some error either in estimating the answer or in working the problem.

Estimating Sums, Differences, Products, and Quotients

When solving problems in which you must add, subtract, multiply, or divide, you can use round numbers in estimating the answers. For example, if you must multiply 91 by 23, you can estimate your answer by thinking:

OWAY

To estimate the cost of 4¾ yards of material at $2.94 a yard, this shopper multiplies $3 by 5. The ability to estimate total cost often comes in handy while shopping.

91 is about 90, and 23 is about 20
Therefore the answer is about 90×20, or 1800

Example: Miriam had $12.00 with which to buy skates and a sweater for her young brother's Christmas gift. At the store she learned that the price of skates was $4.89 and the price of a sweater was $5.74. How much did the two items cost?

To estimate this answer, think:

$4.89 is about $5.00; $5.74 is about $5.75
Therefore the sum is about $10.75

PRACTICE

1. Estimate an answer to each of the following:

a. $4.95 + $2.89	**f.** 4 × $2.04	**k.** $20.13 ÷ 10
b. $90 − $19.95	**g.** 5 × $3.97	**l.** $49.95 ÷ 5
c. $8.87 + $9.91	**h.** 6 × $6.07	**m.** $17.89 ÷ 3
d. $10.05 − $3.07	**i.** 2 × $4.98	**n.** $30.19 ÷ 6
e. $9.79 + $14.95	**j.** 7 × $9.96	**o.** $31.89 ÷ 4

2. A family is supported by the mother and an older daughter. The mother earns $38.25 a week and the daughter earns $54.75 a week. Estimate the family's weekly income.

3. Janet went shopping for a pair of gloves. At one store the gloves she liked were priced at $3.98. At the second store similar gloves were priced at $3.49. Estimate the amount saved by buying at the second store.

4. Donald Miller works in a garage at $97\frac{1}{2}$ cents an hour. One day he worked from 7:00 A.M. to 12:00 noon, and from 1:00 P.M. to 4:15 P.M. Estimate his earnings that day.

5. Mr. Day's car makes 19 miles to a gallon of gasoline. At $25\frac{1}{2}$ cents a gallon, what is your estimate of the cost of gasoline for a trip of 192 miles?

Estimating Percentages

When solving problems in which you must find percentages, you can use fractions in estimating the answers. For example, 74 per cent is nearly 75 per cent, and 75 per cent is three fourths; so to estimate 74 per cent of a number, you take $\frac{3}{4}$ of it. Of course, you can approximate the number as well as the per cent.

Example: In figuring his Federal income tax, Mr. Moss had to find 26 per cent of $358.50. How much is this amount?

To estimate the answer, think:

26% is about 25%, or $\frac{1}{4}$; and $358.50 is about $360
Therefore the answer is about $\frac{1}{4} \times \$360$, or $90

PRACTICE

Estimate each of the following:

1) 39% × 35
2) 67% × 48
3) 124% × 80
4) 151% × 48
5) 19% × $50 *30*
6) 33% × $89.78
7) 66% × $90.36
8) 76% × $39.96
9) 81% × 28
10) 49% × 24

A Plan for Solving Problems

Most students who are successful in solving problems have some kind of plan to follow in their work. One useful plan consists of the following eight steps:

MONKMEYER

The ability to work according to a plan is one of the most valuable skills you can learn. As this picture suggests, a job proceeds with few difficulties when each step is planned.

(1) Read the problem slowly and carefully so that you understand it fully.
(2) Answer the question: What does the problem ask me to find?
(3) Answer the question: What facts are given me with which to work? Read the problem again to make sure you know these facts.
(4) Decide what computations to make to find the answer.
(5) Estimate the answer.
(6) Make your computations carefully.
(7) Compare your answer with the estimated answer to see if it is reasonable. If it is not, do your computations over again.
(8) Check your computations.

PRACTICE

Take the eight steps listed above in solving each of the problems that follow:

1. Muriel's father pays $75 a month rent for their house. At this rate, how much rent does he pay in a year?

2. In November, 1953 there were in the United States 2395 AM and 563 FM radio broadcasting stations and 186 VHF and 82 UHF television stations. What percent of all the stations were television stations?

3. Mrs. Carr bought a bushel of apples at the market for $4.75. At the corner grocery, similar apples are sold at the rate of 3 pounds for 35 cents. The weight of a bushel of apples is 48 pounds. How much did Mrs. Carr save by buying these apples at the market?

4. Sam's father bought an automobile but was unable to pay the full amount in cash at the time of the purchase. The cost of the car, including interest charges for delayed payments, was $945. Of this amount he made a down payment of $315, and is to pay the balance in equal monthly payments extending over one year. How much must he pay each month?

5. At a service station Mr. Roberts bought 10 gallons of gasoline at 31 cents a gallon and 2 quarts of oil at 45 cents a quart. How much change should he have received from a five-dollar bill?

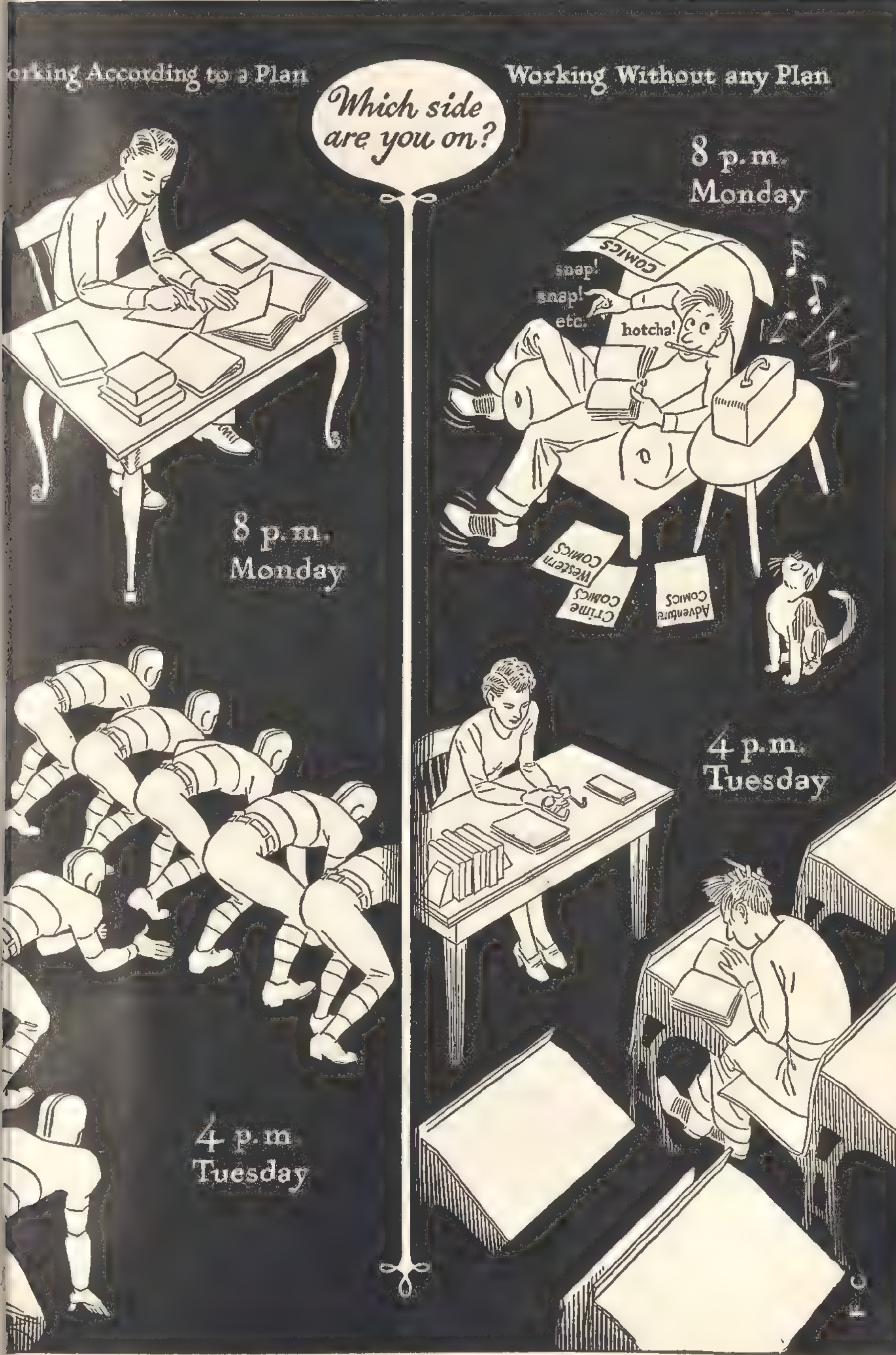
6. In 1954, the passenger planes of a commercial airline made regularly scheduled flights from New York to Los Angeles in 8 hours. The airline distance between these cities is 2451 miles. What was the average speed of these planes in miles per hour?

7. A house valued at $8000 is insured for 75 per cent of its value at the rate of 28 cents per $100. What is the cost of the insurance?

8. The corner grocery allows a discount of 4 per cent for prompt payment of bills. Find how much Mr. Owens saved by paying promptly his bill for $36.50.

9. In the town of Ashville, the tax rate is $20.30 per $1000. Find the tax on a house and lot assessed at $3800.

10. Yoder's hardware store advertises a 10 per cent discount on a food freezer. The regular price is $454.50. Brewer's Department Store offers the same kind of freezer at $435 with a 5 per cent discount. Which price is the better and by how much?



orking According to a Plan
Which side are you on?
Working Without any Plan
8 p.m. Monday
COMICS
snap! snap! etc.
hotcha!
Western Comics
Crime Comics
Adventure Comics
8 p.m. Monday
4 p.m. Tuesday
4 p.m. Tuesday

Review Test on Solving Problems

Your problem-solving skills have probably improved since you began this course. Almost surely, you can improve them still further.

The questions that follow are similar to those at the beginning of this chapter. They will help you learn what improvement you have made by studying this chapter and what skills you need to practice.

Do not work out the answers to these problems. Just select correct statements about each problem.

Can You Tell What You Are to Find?

1. Mrs. Jackson's budget allows her $25.00 a week for food. Her milk bill is 31 cents a day. Last week, in addition to paying her milk bill, she spent $8.60 for groceries, $7.20 for meat, and $6.40 for fruits and vegetables. How much of her weekly allowance did she have left?

This problem asks me to find: (*a*) Mrs. Jackson's food allowance for a week; (*b*) how much Mrs. Jackson spent for food last week; (*c*) the amount of Mrs. Jackson's milk bill for one week; (*d*) how much of her food allowance Mrs. Jackson had left at the end of the week.

2. Every morning Walter Reeve delivers a quart of milk to each of his 34 customers. One week he collected $1.47 from each customer. Find the total amount he collected that week.

This problem asks me to find: (*a*) how much money Walter collected from each customer that week; (*b*) how many customers Walter has; (*c*) how many quarts of milk Walter delivered that week; (*d*) how much money Walter collected from his customers that week.

Do You Know What a Problem Tells You?

3. Margaret Long earns a salary of $250 a month. She spends 12 per cent of this amount for clothing. How much does she spend for clothing in a year?

This problem tells me that: (*a*) Miss Long spends 12 per cent of her salary for clothing; (*b*) Miss Long saves 12 per cent of her salary; (*c*) Miss Long earns $250 a month.

4. Mr. Jones bought 12 gallons of gasoline at $.26 a gallon and a quart of oil for $.35. How much change should he have received from a five-dollar bill?

This problem tells me that: (*a*) Mr. Jones bought 16 gallons of gasoline; (*b*) the gasoline cost 26 cents a gallon; (*c*) Mr. Jones bought 35 quarts of motor oil; (*d*) Mr. Jones handed the station attendant a ten-dollar bill; (*e*) the cost of the motor oil was 35 cents.

5. Mr. Mason would like to buy a farm that is priced at $7500. As he does not have enough money to pay cash for the farm, the Woodville Savings Bank has agreed to loan him 60 per cent of the cost. How much cash will Mr. Mason need to buy the farm?

This problem tells me that: (*a*) the bank has agreed to loan Mr. Mason $7500; (*b*) the price of the farm Mr. Mason wishes to buy is $7500; (*c*) the price of the farm is 60 per cent of the amount the bank has agreed to loan Mr. Mason.

Can You Tell What Facts You Need to Solve a Problem?

6. Esther Nielsen earns $145 a month as a secretary. She begins work at 8:30 A.M. six days a week. Five days a week she works until 5:00 P.M. with an hour off for lunch. On Saturdays she works until noon. She works 12 months a year. How much does she earn in a year?

The facts I must use to find the answer to this problem are: (*a*) the time Esther begins work in the morning; (*b*) the number of hours she works each day; (*c*) the salary she earns each month; (*d*) the number of months she works in a year; (*e*) the number of days she works each week.

7. William Mitchell of South High School earns $8.00 a week working in a grocery store. He has no other income of any kind. William budgets his money carefully so that he saves 30 per cent of his earnings each week. He spends 20 per cent of his earnings for his lunches. How much does he save in a school year of 36 weeks?

The facts that are needed in solving this problem are: (*a*) the per cent of his income William spends for lunches; (*b*) the per cent of his income he saves; (*c*) the amount of his weekly income.

8. Mr. Morris uses 20 gallons of motor oil a year. He can buy a five-gallon can of motor oil for $5.45. The same kind of motor oil in one-gallon cans costs $1.35 a gallon. How much less per gallon does the motor oil cost if bought in five-gallon cans?

The facts that are needed in solving this problem are: (*a*) the cost of a gallon of motor oil if bought in one-gallon cans; (*b*) the cost of a five-gallon can of motor oil; (*c*) the number of gallons of motor oil Mr. Morris uses in a year.

Can You Tell What Facts Are Not Important?

9. Richard Miller and John Hartley plan to attend a football game at a college in an adjoining state. Richard will drive his father's automobile but will have to pay for the gasoline and oil and any other automobile expenses that may arise while he has the car.

In figuring out the cost of the trip, the *least* important fact to consider is: (*a*) the number of miles the car is driven; (*b*) the number of miles the car makes on a gallon of gasoline; (*c*) the cost of gasoline per gallon; (*d*) the time the boys start on the trip.

10. On December 1, James Wilson bought a saxophone on the time-payment plan. After making a down payment, James still owed the dealer $100. He agreed to pay this amount in 6 months with interest at 5 per cent.

In figuring how much James owed the dealer at the end of 6 months, the *least* important fact to consider is: (*a*) the rate of interest; (*b*) the amount of money James owed the dealer; (*c*) the date the saxophone was purchased; (*d*) the length of time James owed the money to the dealer.

Do You Know What Arithmetic Process to Use?

11. Mary received $7.50 as a birthday gift. She plans to use this money to pay part of the cost of a camera. The camera she wishes to buy is priced at $18.95. How much money will she have to add to her birthday gift to pay for the camera?

The process I would use to solve this problem is: (*a*) addition; (*b*) subtraction; (*c*) multiplication; (*d*) division.

12. Jim Stone bought a radio from the Potter Hardware Company. The cash price of the radio was $49.50. As Jim did not wish to pay cash, the dealer agreed to accept in payment $6.75 a month for 8 months. The difference between the cash price of the radio and the amount Jim actually paid is the carrying charge. What was the carrying charge?

The first process I would use to solve this problem is: (*a*) addition; (*b*) subtraction; (*c*) multiplication; (*d*) division.

The next process I would use is: (*e*) addition; (*f*) subtraction; (*g*) multiplication; (*h*) division.

13. Allen Young rides back and forth to work on a bus. He uses 12 bus tickets a week. The cost of one ticket is 25 cents. He can buy a book containing 12 tickets for $2.75. How much can he save on his bus fare each week by buying a book of tickets rather than one ticket at a time?

The first process to use in solving this problem is: (*a*) addition; (*b*) subtraction; (*c*) multiplication; (*d*) division.

The next process to use is: (*e*) addition; (*f*) subtraction; (*g*) multiplication; (*h*) division.

Can You Tell What to Do to Find the Answer?

14. Five girls agreed to share the expenses of a party for their friends. They spent $5.75 for the makings of sandwiches, cookies, and punch, and they bought 9 quarts of ice cream costing 75 cents a quart. What was each girl's share of the expenses?

The correct method of finding the answer to this problem is:

(*a*) $\$5.75 \div 5 = \$1.15$
$9 \times \$.75 = \$6.75$
$\$1.15 + \$6.75 = \text{Answer}$

(*b*) $9 \times \$.75 = \$6.75$
$\$6.75 \div 5 = \$1.35$
$\$5.75 + \$1.35 = \text{Answer}$

(*c*) $9 \times \$.75 = \$6.75$
$\$5.75 + \$6.75 = \$12.50$
$\$12.50 \div 5 = \text{Answer}$

(*d*) $9 + 75 = 84$
$\$5.75 + \$.84 = \$6.59$
$\$6.59 \div 5 = \text{Answer}$

15. Robert Ellis bought a car for $875. His old car, for which he was allowed $225, was accepted as a down payment. The amount unpaid was divided into 12 equal monthly payments. What was the amount of each monthly payment?

To find the answer to this problem I would: (*a*) add $225 to $875 and divide the result by 12; (*b*) subtract $225 from $875, and multiply the result by 12; (*c*) add $225 to $875 and multiply the sum by 12; (*d*) subtract $225 from $875 and divide the difference by 12.

16. Grace Martin has a savings account in which she deposits $2.50 a week, 52 weeks a year. Her salary is $1600 a year. What per cent of her salary does she deposit in her savings account?

To find the answer to this problem I would: (*a*) multiply $2.50 by 52, divide the product by $1600, and place a per cent sign after the result; (*b*) multiply $2.50 by 52, divide the result by $1600, and change the result to a per cent; (*c*) multiply $2.50 by 52 and divide the product by $1600; (*d*) divide $2.50 by 52, multiply the result by $1600, and change the product to a per cent.

How Good Are You at Estimating Answers?

17. Richard Spencer works as a delivery boy for the Corner Grocery after school and on Saturdays. Last week he worked $1\frac{1}{2}$ hours on Monday, $2\frac{1}{4}$ hours on Tuesday, $2\frac{1}{4}$ hours on Friday, and $3\frac{1}{2}$ hours on Saturday. He received 80 cents an hour. How much did Richard earn as a delivery boy last week?

From the information given I know that Richard earned: (*a*) between $7 and $8; (*b*) a little more than $4; (*c*) a little less than $10; (*d*) about $15.

18. Paul Smith earns part of his college expenses by working as a soda-jerker. He receives 90 cents an hour for the time he works. His last class ends at 2:00 P.M. and he begins work as soon after as he can get to the store. He must begin work not later than 3:00 P.M. He stops work each evening at 5:30 P.M.

From this information I know that each day Paul earns: (*a*) between $.90 and $1.80; (*b*) a little less than $4; (*c*) about $6; (*d*) at least $2.25.

19. Owen Rice is paid \$1.50 an hour for working 40 hours a week. For any time he works in addition to 40 hours, he receives \$2.25 an hour. One week he worked 45 hours. How much did he earn that week?

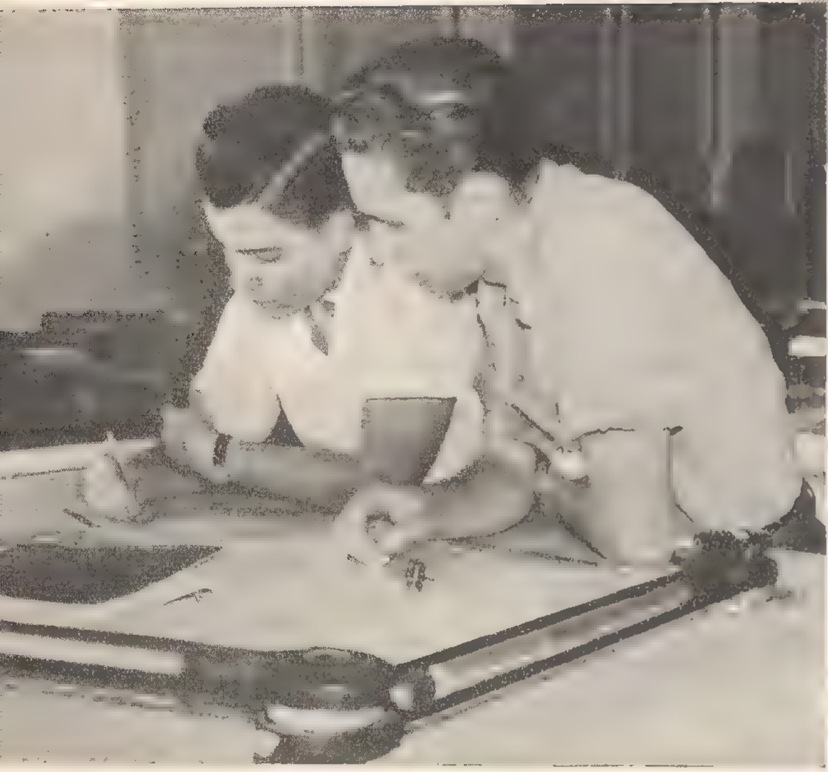
My estimate of the answer to this problem is: (*a*) \$60; (*b*) \$85; (*c*) \$70; (*d*) \$100.

20. Jane Douglas is planning to buy a wrist watch that is marked \$29.95. A discount of 3 per cent is offered for cash payment. How much can Jane save by paying cash for the watch?

My estimate of the answer is: (*a*) \$.30; (*b*) \$.09; (*c*) \$.90; (*d*) \$9.00.

How do you rate?	Excellent	Good	Fair	Poor
	19–20	17–18	14–16	13 or less

CHAPTER 2



GALLOWAY

Please remember that
it takes a little effort
to drive a car,
or to swim,
or to do almost anything.
But, if the result is worth while,
why growl at the effort?
After all,
the only way to make no effort at all
is to be dead!

H. G. and L. R. Lieber, *The Education of T. C. Mits.* W. W. Norton, 1944

ARITHMETIC REVISITED

THERE ARE TWO REASONS why people have difficulty with arithmetic even after they have studied it all through grade school. One is that they do not really understand what they are doing: they just blindly follow rules. The other is that they do not remember number facts. As you study this chapter you will find that it explains arithmetic processes and provides the kind of practice that should help you remember number facts.

Can you imagine what would happen to a clerk in a department store or to a gasoline-station attendant who was accurate with numbers only 80 or perhaps 90 per cent of the time? He would very likely lose his job after a day or two. Anyone who uses numbers should be 100 per cent accurate in all his computations.

Try-Out Tests on Computation

The short tests that follow will help you learn how accurate you are. Work rapidly but carefully. Copy the items only when necessary. *Do not write in this book.*

TEST ON WHOLE NUMBERS

Add:

1)	2)	3)	4)	5)
9	7	16	29	99
4	8	35	37	86
2	9	7	3	87
	5	29	45	63
		5	7	

6)	7)	8)	9)	10)
490	247	4,536	2,579	56,908
92	31	1,628	520	2,587
394	156	595	1,898	12,370
27	628	783	697	1,405
	48		432	61,578

Subtract:

11)	12)	13)	14)	15)
75	91	832	736	300
21	57	425	289	74

16)	17)	18)
4,050	1,504	6,823
3,896	405	3,068

19)	20)
69,000	78,018
45,683	46,979

Multiply:

21)	22)	23)	24)	25)
603	851	243	315	2,517
2	3	4	8	6

26)	27)	28)
145	806	492
56	87	600

29)	30)
1,407	567
23	409

Divide:

31) $3\overline{)363}$

32) $4\overline{)244}$

33) $8\overline{)560}$

34) $9\overline{)7,290}$

35) $5\overline{)2,723}$

36) $22\overline{)484}$

37) $38\overline{)76,000}$

38) $57\overline{)5,759}$

39) $19\overline{)12,485}$

40) $65\overline{)6,955}$

How do you rate?	Excellent	Good	Fair	Poor
	40	38–39	35–37	34 or less

TEST ON COMMON FRACTIONS

Add:

1) $\begin{array}{r} \frac{5}{6} \\ \underline{\frac{1}{6}} \end{array}$

2) $\begin{array}{r} 4\frac{1}{2} \\ \underline{2\frac{1}{3}} \end{array}$

3) $\begin{array}{r} 3\frac{1}{6} \\ \underline{2\frac{2}{3}} \end{array}$

4) $\begin{array}{r} \frac{7}{16} \\ \underline{\frac{1}{2}} \end{array}$

5) $\begin{array}{r} 5\frac{3}{4} \\ \underline{3\frac{2}{3}} \end{array}$

6) $\begin{array}{r} 2\frac{3}{4} \\ 1\frac{1}{8} \\ \underline{5\frac{1}{2}} \end{array}$

7) $\frac{1}{4} + \frac{2}{4}$

8) $\frac{1}{8} + \frac{1}{4}$

9) $\frac{7}{8} + \frac{3}{8}$

10) $\frac{1}{2} + \frac{3}{5} + \frac{7}{10}$

Subtract:

11) $\begin{array}{r} \frac{13}{16} \\ \underline{\frac{5}{16}} \end{array}$ 12) $\begin{array}{r} \frac{7}{8} \\ \underline{\frac{3}{4}} \end{array}$ 13) $\begin{array}{r} \frac{2}{3} \\ \underline{\frac{1}{4}} \end{array}$ 14) $\begin{array}{r} 4\frac{5}{6} \\ \underline{3\frac{1}{6}} \end{array}$ 15) $\begin{array}{r} 7\frac{4}{5} \\ \underline{3\frac{1}{2}} \end{array}$

16) $\begin{array}{r} 4 \\ \underline{2\frac{3}{4}} \end{array}$ 17) $6\frac{3}{8} - 1\frac{1}{8}$ 18) $16\frac{1}{2} - 5\frac{5}{8}$

19) $\frac{1}{3} - \frac{1}{12}$ 20) $7\frac{2}{5} - 4\frac{4}{5}$

Multiply:

21) $\frac{1}{3} \times 15$

22) $\frac{5}{8} \times 24$

23) $\frac{1}{2} \times \frac{1}{4}$

24) $\frac{2}{5} \times 8\frac{1}{3}$

25) $\frac{5}{8} \times \frac{7}{10}$

26) $3 \times 4\frac{1}{2}$

27) $4\frac{1}{3} \times 1\frac{4}{5}$

28) $4\frac{1}{2} \times 6\frac{2}{3} \times \frac{4}{5}$

29) $\begin{array}{r} 240 \\ \underline{5\frac{2}{3}} \end{array}$

30) $\begin{array}{r} 32\frac{1}{3} \\ \underline{4} \end{array}$

Divide:

31) $\frac{7}{8} \div \frac{7}{8}$

32) $\frac{9}{10} \div \frac{3}{10}$

33) $3\frac{1}{3} \div \frac{1}{3}$

34) $5\frac{1}{3} \div 3\frac{1}{5}$

35) $12 \div \frac{3}{4}$

36) $10 \div \frac{1}{2}$

37) $10\frac{1}{3} \div 5\frac{1}{6}$

38) $\frac{3}{4} \div 2$

39) $6\frac{9}{10} \div 3$

40) $8 \div 2\frac{3}{4}$

How do you rate?	Excellent	Good	Fair	Poor
	39–40	36–38	30–35	29 or less

TEST ON DECIMAL FRACTIONS

Add:

1) .7 + .6 + .9 .12

2) .94 + .20 + .76 1.90

3) 2.29 + 5.34 + 6.70 14.23

4) .38 + .08 + 5.63 + .47 5.96

5) 1.675 + 7.860 + .429 4

6) \$.39 + \$.12 + \$.53 + \$.27

7) \$3.25 + \$6.40 + \$18.75

Subtract:

8) 4.6 – 2.7

9) .43 – .39

10) 71.6 – 45

11) 4.67 – 2.39

12) 2.441 – 1.406

13) \$7.03 – \$.56

14) \$43 – \$6.78

Multiply:

15) $\begin{array}{r} 4.8 \\ \underline{3.5} \end{array}$

16) $\begin{array}{r} 3.08 \\ \underline{.46} \end{array}$

17) $\begin{array}{r} 42.7 \\ \underline{1.03} \end{array}$

18) 56 × \$.25

19) 160 × \$.375

Divide:

20) $3\overline{)\$.54}$

21) $32\overline{)\$7.36}$

22) $.86\overline{)430}$

23) 110 ÷ 16

24) 6.28 ÷ 1.2

Place the decimal point in each answer:

25) 240 × .025 = 6000

26) 1.8 × .4 = 72

27) 100 × 7.3 = 7300

28) 410.7 ÷ 100 = 4107

29) 800.28 ÷ 32.4 = 247

30) .072 ÷ .6 = 12

How do you rate?	Excellent	Good	Fair	Poor
	29–30	27–28	25–26	24 or less

TEST ON PER CENT

1. Write .16 as a per cent.
2. Express 4% as a decimal.
3. Express 25% as a common fraction in simplest form.
4. Express $\frac{1}{5}$ as a per cent.
5. Express .075 as a per cent.
6. Write 2.3% as a decimal fraction.
7. Change $62\frac{1}{2}$% to a common fraction in lowest terms.
8. Express $\frac{1}{8}$ as a per cent.
9. What is 16 per cent of 225?
10. What per cent of 24 is 12?
11. Sixty is 25 per cent of what number?
12. How much is 85 per cent of 300?
13. What per cent of $4.00 is $3.20?
14. Fifteen is 20 per cent of what number?
15. What is $66\frac{2}{3}$ per cent of 75?
16. What per cent of 60 is 42?
17. Ten dollars is 5 per cent of what amount?
18. What is 2.5 per cent of 340?
19. What per cent of $40,000 is $2400?
20. Seventy-five is $33\frac{1}{3}$ per cent of what number?

How do you rate?	Excellent	Good	Fair	Poor
	20	18–19	15–17	14 or less

If you made errors in these tests, you should try to find out why. It may be that you do not understand some of the procedures. On the following pages you will find an explanation of each arithmetic process — even the simplest. As you study them, you will "revisit" arithmetic.

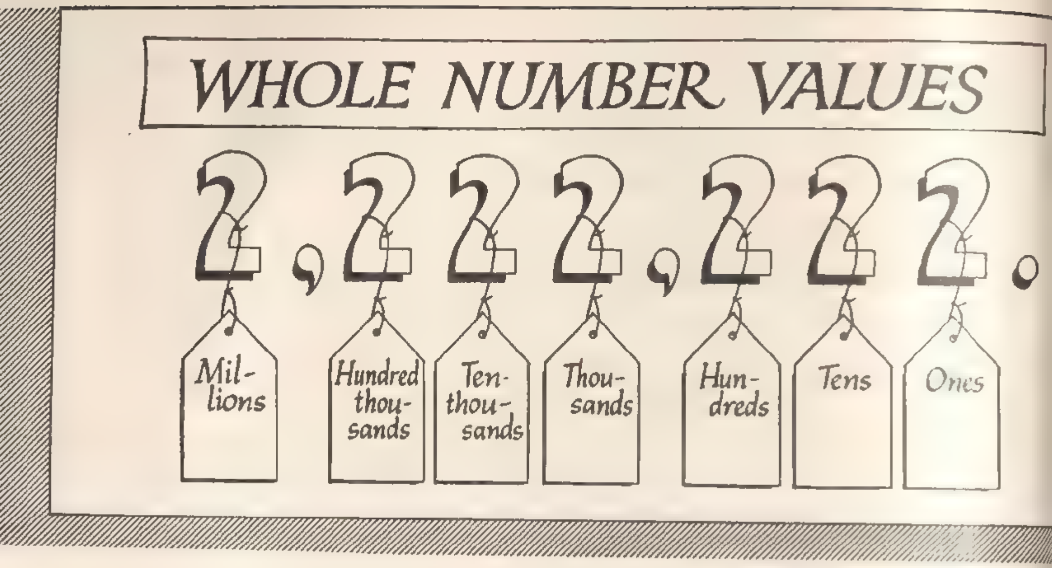


Figure 2–1

UNDERSTANDING WHOLE NUMBERS

The number 2,222,222 (two million, two hundred twenty-two thousand, two hundred twenty-two) is made up of the figure 2 written seven times. But each 2 has a different value. The 2 farthest to the right represents the number of units or ones; the 2 second from the right represents the number of tens; the 2 third from the right tells the number of hundreds, and so on as shown in Figure 2–1.

A *one-place number* contains one figure, in the ones place. The one-place number 3 means 3 units, or 3 ones. A *two-place number* contains two figures, one each in the tens and ones places. The two-place number 64 means 6 tens and 4 units. A *three-place* number contains three figures, one each in the hundreds, tens, and ones places. You can go on like this indefinitely.

A whole number may be written with a period, called a *decimal point*, after the ones place. The decimal point does not change the value of the number.

PRACTICE

1. Name all the one-place numbers.

2. What does the number 7 mean?

3. What does the two-place number 42 mean?

4. In the number 20, what does the zero show?

5. What does the three-place number 941 mean?

6. In the number 605, what does the zero show?

7. In the number 700, what does the zero farthest to the right show?

8. In the number 34,567 what does the 7 tell? What does each of the other figures tell?

9. Give the numbers with these meanings:

a. 6 tens and 7 units

b. 5 tens and no units

c. 9 tens and 8 ones

d. 1 ten and 5 units

e. 2 tens and 1 unit

f. 3 hundreds, no tens, and 5 units

g. 4 hundreds, 4 tens, and 4 units

The readings of these electric measuring instruments are to be used in computation. The computations, as well as the readings, must be accurate.

ROBERTS

10. What does each of these numbers mean?

a. 49	**h.** 580
b. 27	**i.** 850
c. 16	**j.** 763
d. 92	**k.** 984
e. 80	**l.** 3671
f. 461	**m.** 9865
g. 508	**n.** 4708

Addition of Whole Numbers

Each number that is added is called an *addend*. The result of an addition is called the *sum*. For example:

3	ADDEND
+ 2	ADDEND
5	SUM

A good way to avoid mistakes in addition is to practice some very simple sums. There are actually only one hundred different number facts in addition. Here they are:

1	1	2	4	1	1	7	2	3	1
+ 1	+ 4	+ 2	+ 1	+ 7	+ 2	+ 1	+ 1	+ 3	+ 0
4	1	5	4	0	6	1	2	0	3
+ 5	+ 6	+ 4	+ 4	+ 1	+ 1	+ 3	+ 5	+ 0	+ 1
5	2	2	3	1	5	7	2	8	1
+ 2	+ 3	+ 0	+ 2	+ 8	+ 1	+ 2	+ 4	+ 1	+ 5
2	0	4	2	3	3	6	5	3	4
+ 7	+ 2	+ 2	+ 6	+ 5	+ 4	+ 2	+ 3	+ 0	+ 3
3	1	4	6	2	6	9	8	2	5
+ 6	+ 9	+ 0	+ 3	+ 8	+ 6	+ 1	+ 2	+ 9	+ 5
4	9	6	3	6	7	3	5	8	0
+ 6	+ 2	+ 7	+ 8	+ 4	+ 6	+ 7	+ 7	+ 3	+ 3
7	5	8	6	8	5	8	0	7	6
+ 5	+ 6	+ 6	+ 5	+ 8	+ 0	+ 4	+ 4	+ 3	+ 8
0	4	8	9	6	9	5	7	8	7
+ 5	+ 8	+ 9	+ 3	+ 0	+ 8	+ 9	+ 9	+ 7	+ 0
9	3	9	0	4	9	5	9	0	6
+ 0	+ 9	+ 9	+ 6	+ 7	+ 6	+ 8	+ 4	+ 7	+ 9
0	7	7	9	8	4	8	7	9	0
+ 8	+ 8	+ 4	+ 5	+ 5	+ 9	+ 0	+ 7	+ 7	+ 9

Adding One-Place Numbers

Example: Find the sum of 8, 7, and 9.

(1) Copy the numbers in a column, and draw a line beneath them. Start at the top of the column and add the numbers in order. Think: 8, 15, 24. Write the last sum beneath the line, like this:

$$\begin{array}{r} 8 \\ 7 \\ \underline{9} \\ 24 \end{array}$$

(2) Check by adding upward from the bottom of the column.

Note: To add one-place numbers without copying them, add the numbers mentally in order from left to right. Check by adding from right to left.

PRACTICE

Add each of the following groups of numbers. Check your work.

1) 1 + 5 + 4 + 1
2) 9 + 1 + 7 + 8
3) 4 + 1 + 3 + 2 + 5
4) 5 + 3 + 4 + 5 + 7
5) 5 + 5 + 3 + 7 + 8
6) 7 + 7 + 5 + 6 + 8
7) 9 + 6 + 5 + 5 + 3
8) 7 + 9 + 8 + 9 + 7
9) 6 + 7 + 8 + 7 + 6
10) 9 + 7 + 6 + 5 + 6
11) 7 + 6 + 5 + 9 + 3
12) 4 + 5 + 6 + 9 + 8 + 8
13) 4 + 2 + 8 + 6 + 7 + 9
14) 4 + 6 + 4 + 9 + 1 + 3
15) 5 + 8 + 7 + 6 + 4 + 9
16) 8 + 3 + 7 + 9 + 6 + 5
17) 9 + 9 + 8 + 6 + 7 + 9
18) 8 + 9 + 7 + 6 + 6 + 8
19) 8 + 9 + 9 + 3 + 0 + 7
20) 5 + 8 + 9 + 0 + 4 + 6
21) 1 + 9 + 4 + 5 + 5 + 7
22) 9 + 7 + 6 + 9 + 7 + 4
23) 4 + 4 + 5 + 8 + 9 + 8
24) 8 + 5 + 5 + 1 + 1 + 3
25) 5 + 7 + 6 + 9 + 7 + 7
26) 6 + 5 + 2 + 6 + 8 + 3
27) 9 + 9 + 9 + 8 + 4 + 7
28) 3 + 4 + 3 + 5 + 5 + 8
29) 8 + 6 + 5 + 6 + 8 + 4
30) 7 + 7 + 8 + 7 + 9 + 9

Carrying in Addition

Example: Find the sum of 867 and 356.

(1) Copy the numbers in columns, lining up the figures in the ones places, the tens places, and the hundreds places. Draw a line beneath the columns.

```
Like this:  8 6 7        Not like this:   8 6 7
            3 5 6                       3 5 6
            -----                       -----
```

(2) Add the ones column. Think: 7, 13. Write the 3 beneath the ones column. Write the 1 above the tens column.

Think: 1, 7, 12. Write the 2 beneath the tens column. Write the 1 above the hundreds column.

Add the hundreds column. Think: 1, 9, 12. Write the answer beneath the line, in the hundreds and thousands places.

```
   1 1
   8 6 7
   3 5 6
 -------
 1 2 2 3   Answer
```

(3) Check your work, adding upward from the bottom.

PRACTICE

Copy the numbers in each exercise and add them. Check your addition.

1) 27, 15
2) 36, 28
3) 49, 25
4) 88, 27
5) 93, 48
6) 56, 36
7) 57, 76
8) 97, 6
9) 8, 96
10) 9, 94
11) 173, 394
12) 290, 425
13) 285, 690
14) 167, 781
15) 185, 440
16) 272, 556
17) 863, 65
18) 12, 794
19) 272, 330, 305
20) 106, 73, 540
21) 465, 178
22) 786, 175
23) 148, 259
24) 674, 259
25) 557, 348
26) 175, 375
27) 436, 287
28) 359, 87
29) 96, 458
30) 84, 979

"He's not so dumb at arithmetic. He's figured out exactly how many hours till summer vacation."

Subtraction of Whole Numbers

When you subtract one number from another, the result is called the *difference*. The number from which you subtract is called the *minuend*. The number subtracted is called the *subtrahend*. Thus:

$$\begin{array}{rl} 6 & \text{MINUEND} \\ \underline{-\ 2} & \text{SUBTRAHEND} \\ 4 & \text{DIFFERENCE} \end{array}$$

To avoid mistakes in subtraction, practice giving the following one hundred differences. You should be able to give each difference as rapidly as you can say the proper word. If you can do so, you know all the number facts you need to do subtraction problems correctly.

5	3	4	5	3	8	2	8	1	9
− 1	− 2	− 2	− 4	− 1	− 1	− 1	− 7	− 0	− 1
6	9	6	4	6	0	8	4	5	2
− 5	− 8	− 3	− 3	− 1	− 0	− 4	− 1	− 3	− 0
5	7	6	3	7	7	6	9	7	9
− 2	− 1	− 2	− 0	− 6	− 5	− 4	− 5	− 2	− 4
1	8	7	9	8	7	4	3	9	8
− 1	− 6	− 3	− 3	− 2	− 4	− 0	− 3	− 6	− 3
5	8	9	10	11	10	2	9	10	13
− 0	− 5	− 7	− 2	− 9	− 9	− 2	− 2	− 1	− 9
4	10	9	11	12	6	10	12	13	5
− 4	− 8	− 9	− 2	− 6	− 0	− 7	− 3	− 4	− 5
7	10	12	10	10	16	10	16	6	8
− 0	− 5	− 9	− 4	− 3	− 9	− 6	− 7	− 6	− 0
12	7	14	9	11	14	8	11	18	13
− 8	− 7	− 5	− 0	− 8	− 7	− 8	− 3	− 9	− 5
12	14	11	14	12	11	15	13	12	13
− 4	− 9	− 5	− 8	− 7	− 6	− 8	− 6	− 5	− 8
11	14	15	16	11	15	13	15	17	17
− 7	− 6	− 9	− 8	− 4	− 7	− 7	− 6	− 9	− 8

Finding Differences

Example: Find the difference between 217 and 429.

(1) Copy the numbers, writing the smaller beneath the larger. Line up the figures in the ones places, the tens places, and the hundreds places. Draw a line beneath the subtrahend.

(2) Find the difference between the numbers in the ones place. Write it in the ones column beneath the line. Repeat with the numbers in the other places.

$$\begin{array}{r} 429 \\ -\,217 \\ \hline 212 \end{array} \quad \text{Answer}$$

(3) Check by adding the difference to the subtrahend. The sum should equal the minuend.

$$\begin{array}{r} 212 \\ +\,217 \\ \hline 429 \end{array} \quad \text{Check}$$

PRACTICE

Subtract and check, according to the procedure just given.

1) 53, 12	**11)** 833, 964
2) 69, 58	**12)** 206, 637
3) 57, 21	**13)** 363, 398
4) 63, 87	**14)** 598, 57
5) 75, 98	**15)** 439, 36
6) 189, 59	**16)** 8281, 1170
7) 147, 37	**17)** 1128, 6149
8) 124, 13	**18)** 7769, 6545
9) 25, 157	**19)** 9874, 3240
10) 34, 168	**20)** 4398, 1363

Borrowing in Subtraction

Example: Find the difference between 735 and 356.

(1) Copy the numbers, writing the smaller beneath the larger. Line up the columns and draw a line beneath the subtrahend.

$$\begin{array}{r} 735 \\ -\,356 \\ \hline \end{array}$$

(2) Start with the numbers in the ones place. You cannot take 6 from 5; so borrow 1 ten from the tens column. To show what you have done, you may cross out the 3 in the tens column and write 2 above it. Remember that you now have 15 ones. Subtract 6 from 15, and write the difference beneath the ones column.

Go on to the tens column. Since you cannot take 5 from 2, borrow 1 hundred from the hundreds column. You may show what you have done by crossing out the 7 in the hundreds column and writing 6 above it. Remember that now you have 12 tens. Subtract 5 from 12 and write the difference beneath the tens column.

Now go on to the hundreds column. Remember that only 6 hundreds are left in the minuend. Subtract 3 from 6. Your work will look this way:

$$\begin{array}{r} \overset{6}{\cancel{7}}\overset{2}{\cancel{3}}5 \\ -\ 356 \\ \hline 379 \end{array} \quad \text{Answer}$$

(3) Check by adding the difference to the subtrahend.

PRACTICE

Subtract and check, according to the procedure given above.

1) 76, 27

2) 95, 28

3) 63, 35

4) 64, 25

5) 91, 17

6) 72, 48

7) 36, 70

8) 38, 45

9) 24, 61

10) 57, 72

11) 729, 564

12) 675, 394

13) 543, 173

14) 828, 392

15) 271, 937

16) 42, 213

17) 73, 148

18) 85, 238

19) 3462, 1181

20) 4819, 2536

21) 742, 564
22) 952, 775
23) 231, 400
24) 474, 930
25) 15, 200
26) 65, 954
27) 596, 498
28) 633, 368
29) 725, 226
30) 700, 247
31) 93, 58
32) 75, 36
33) 64, 27
34) 95, 46
35) 15, 61
36) 49, 92
37) 2643, 145
38) 3876, 698
39) 286, 4585
40) 198, 6275

NATIONAL EDUCATION ASSOCIATION

In the course of raising this prize-winning steer, his young owner found that his ability to make accurate computations proved helpful. He not only had to figure his costs, but he also had to calculate the amounts of vitamins, minerals, and other food substances the animal required.

Multiplication of Whole Numbers

When you multiply two numbers, the result is called the *product.* The number that you multiply is called the *multiplicand.* The number by which you multiply is called the *multiplier.*

32	MULTIPLICAND
× 4	MULTIPLIER
128	PRODUCT

In some multiplications, you have partial products, which you must add together to get the product. For example:

$$\begin{array}{rl} 21 & \\ \times\ 13 & \\ \hline 63 & \text{PARTIAL PRODUCT} \\ 21 & \text{PARTIAL PRODUCT} \\ \hline 273 & \text{PRODUCT} \end{array}$$

One hundred number facts in multiplication follow. You should be able to give every one of the products without stopping to think.

2	6	0	1	8	2	1	2	5	9
× 2	× 2	× 0	× 1	× 2	× 3	× 0	× 1	× 6	× 5
2	6	3	4	3	3	9	0	5	4
× 5	× 5	× 1	× 3	× 6	× 8	× 3	× 1	× 9	× 7
5	2	4	7	2	8	3	2	7	8
× 2	× 6	× 1	× 3	× 8	× 3	× 4	× 0	× 5	× 9
7	3	1	2	6	3	3	0	5	7
× 2	× 0	× 3	× 9	× 3	× 5	× 9	× 2	× 5	× 4
2	3	1	5	2	9	5	5	4	9
× 7	× 2	× 4	× 3	× 4	× 2	× 0	× 1	× 4	× 8
3	4	6	3	4	0	1	5	4	7
× 3	× 0	× 1	× 7	× 2	× 3	× 2	× 4	× 6	× 7
0	1	7	1	0	7	1	9	6	7
× 5	× 6	× 0	× 9	× 4	× 1	× 8	× 4	× 0	× 8
1	5	4	0	1	8	8	6	5	9
× 5	× 7	× 5	× 6	× 7	× 5	× 0	× 6	× 8	× 6
0	8	6	4	9	8	4	6	0	9
× 7	× 1	× 4	× 9	× 1	× 6	× 8	× 8	× 8	× 7
6	6	8	7	0	8	7	8	9	9
× 7	× 9	× 4	× 6	× 9	× 7	× 9	× 8	× 0	× 9

The Multiplication Tables

If you cannot say the multiplication tables, study them until you can. Here they are:

$2 \times 1 = 2$	$3 \times 1 = 3$	$4 \times 1 = 4$	$5 \times 1 = 5$
$2 \times 2 = 4$	$3 \times 2 = 6$	$4 \times 2 = 8$	$5 \times 2 = 10$
$2 \times 3 = 6$	$3 \times 3 = 9$	$4 \times 3 = 12$	$5 \times 3 = 15$
$2 \times 4 = 8$	$3 \times 4 = 12$	$4 \times 4 = 16$	$5 \times 4 = 20$
$2 \times 5 = 10$	$3 \times 5 = 15$	$4 \times 5 = 20$	$5 \times 5 = 25$
$2 \times 6 = 12$	$3 \times 6 = 18$	$4 \times 6 = 24$	$5 \times 6 = 30$
$2 \times 7 = 14$	$3 \times 7 = 21$	$4 \times 7 = 28$	$5 \times 7 = 35$
$2 \times 8 = 16$	$3 \times 8 = 24$	$4 \times 8 = 32$	$5 \times 8 = 40$
$2 \times 9 = 18$	$3 \times 9 = 27$	$4 \times 9 = 36$	$5 \times 9 = 45$

$6 \times 1 = 6$	$7 \times 1 = 7$	$8 \times 1 = 8$	$9 \times 1 = 9$
$6 \times 2 = 12$	$7 \times 2 = 14$	$8 \times 2 = 16$	$9 \times 2 = 18$
$6 \times 3 = 18$	$7 \times 3 = 21$	$8 \times 3 = 24$	$9 \times 3 = 27$
$6 \times 4 = 24$	$7 \times 4 = 28$	$8 \times 4 = 32$	$9 \times 4 = 36$
$6 \times 5 = 30$	$7 \times 5 = 35$	$8 \times 5 = 40$	$9 \times 5 = 45$
$6 \times 6 = 36$	$7 \times 6 = 42$	$8 \times 6 = 48$	$9 \times 6 = 54$
$6 \times 7 = 42$	$7 \times 7 = 49$	$8 \times 7 = 56$	$9 \times 7 = 63$
$6 \times 8 = 48$	$7 \times 8 = 56$	$8 \times 8 = 64$	$9 \times 8 = 72$
$6 \times 9 = 54$	$7 \times 9 = 63$	$8 \times 9 = 72$	$9 \times 9 = 81$

Multiplying by a One-Place Number

Example: Multiply 45 by 3.

(1) Write the multiplier beneath the multiplicand, lining up the ones places. Draw a line beneath the multiplier.

$$\begin{array}{r} 45 \\ \underline{\times\,3} \end{array}$$

(2) Multiply the figures in the ones places.

Think: $3 \times 5 = 15$.

Write the 5 of the product beneath the multiplier, in the ones

place. Carry the 1 in your mind until you have multiplied the figure in the tens place; then add it to the product.

Think: $3 \times 4 = 12$; $12 + 1 = 13$.

Write the answer in the tens and hundreds places beneath the rule. Your work will look this way:

$$\begin{array}{r} 45 \\ \times\ 3 \\ \hline 135 \end{array} \text{ Answer}$$

(3) Check your work. Write the multiplicand as many times as the number by which you multiplied, and then add.

$$\begin{array}{r} 45 \\ 45 \\ 45 \\ \hline 135 \end{array} \text{ Check}$$

PRACTICE

Find each of the following products.

1) 2 × 48
2) 5 × 41
3) 3 × 38
4) 2 × 264
5) 5 × 801
6) 3 × 273
7) 4 × 152
8) 6 × 33
9) 4 × 251
10) 6 × 532
11) 7 × 56
12) 7 × 513
13) 6 × 512
14) 7 × 305
15) 9 × 253
16) 8 × 315
17) 8 × 948
18) 9 × 1807
19) 8 × 819
20) 9 × 607
21) 2 × 863
22) 3 × 1917
23) 3 × 1721
24) 4 × 915
25) 5 × 321
26) 4 × 235
27) 5 × 1839
28) 5 × 5035
29) 4 × 1292
30) 6 × 171

Multipliers Greater Than Ten

Example: Multiply 647 by 82.

(1) Write the multiplier beneath the multiplicand, lining up the figures in the ones, tens, and hundreds places. Draw a line beneath the multiplier.

$$\begin{array}{r} 647 \\ \times\ 82 \\ \hline \end{array}$$

(2) Multiply by the figure in the ones place of the multiplier. Write the partial product beneath the line. Repeat with the figure in the tens place of the multiplier. Write this partial product beneath the first one, beginning in the tens place rather than the ones place. Add the partial products. Your work will look like this:

$$\begin{array}{rl} 647 & \\ \times\ 82 & \\ \hline 1294 & \\ 5176 & \\ \hline 53054 & \text{Answer} \end{array}$$

(3) To check your work, interchange the multiplier and the multiplicand, and find the product.

$$\begin{array}{rl} 82 & \\ \times\ 647 & \\ \hline 574 & \\ 328 & \\ 492 & \\ \hline 53054 & \text{Check} \end{array}$$

PRACTICE

Find the product, checking your work as shown above.

1) 16 × 21	**6)** 24 × 435	**11)** 68 × 875
2) 23 × 12	**7)** 15 × 206	**12)** 13 × 225
3) 47 × 32	**8)** 32 × 147	**13)** 16 × 528
4) 51 × 45	**9)** 41 × 518	**14)** 72 × 405
5) 67 × 78	**10)** 25 × 329	**15)** 34 × 350

16) 48 × 924

17) 93 × 156

18) 88 × 597

19) 94 × 489

20) 67 × 375

21) 78 × 480

22) 57 × 764

23) 162 × 344

24) 875 × 436

25) 413 × 124

26) 425 × 341

27) 253 × 418

28) 241 × 435

29) 325 × 247

30) 413 × 689

31) 112 × 475

32) 416 × 342

33) 415 × 132

34) 378 × 415

35) 619 × 421

36) 884 × 728

37) 289 × 2341

38) 523 × 2415

39) 493 × 3241

40) 251 × 2568

WIDE WORLD

In preparing for a picnic, the number of hot dogs each person is expected to eat must be multiplied by the number of persons to be served.

Zero in the Multiplier

Sometimes a multiplier contains a zero. In this case, multiply as usual, but remember that the product of zero and any other number is zero. Be careful to write the figures in the products in the correct places.

Examples:

$$\begin{array}{r} 564 \\ \times 70 \\ \hline 39480 \end{array} \quad \text{Answer}$$

$$\begin{array}{r} 312 \\ \times 206 \\ \hline 1872 \\ 6240 \\ \hline 64272 \end{array} \quad \text{Answer}$$

PRACTICE

Multiply and check.

1) 20 × 32	**11)** 80 × 409
2) 40 × 31	**12)** 300 × 436
3) 30 × 37	**13)** 400 × 543
4) 50 × 246	**14)** 500 × 762
5) 60 × 367	**15)** 600 × 489
6) 205 × 453	**16)** 240 × 120
7) 706 × 672	**17)** 270 × 620
8) 403 × 925	**18)** 105 × 750
9) 308 × 473	**19)** 204 × 808
10) 907 × 291	**20)** 600 × 900

Division of Whole Numbers

The result of a division is a *quotient*. A number that you divide is called a *dividend*. A number by which you divide is called a *divisor*.

```
   6   QUOTIENT
3)18   DIVIDEND
↑──────DIVISOR
```

Division is the reverse of multiplication. The quotient multiplied by the divisor gives the dividend: $6 \times 3 = 18$.

Not all divisions "come out even." When the quotient is not a whole number, the part that is left over is called the *remainder*.

```
   4
4)19
  16
   3   REMAINDER
```

The number facts in division appear on the next page. You should be able to give the quotients without pausing to think.

$2\overline{)18}$	$5\overline{)30}$	$1\overline{)1}$	$6\overline{)12}$	$2\overline{)2}$	$7\overline{)28}$	$1\overline{)7}$	$9\overline{)81}$	$2\overline{)8}$
$5\overline{)35}$	$4\overline{)36}$	$6\overline{)6}$	$7\overline{)14}$	$5\overline{)25}$	$9\overline{)63}$	$4\overline{)12}$	$8\overline{)16}$	$6\overline{)24}$
$1\overline{)4}$	$6\overline{)18}$	$8\overline{)8}$	$2\overline{)16}$	$4\overline{)32}$	$7\overline{)35}$	$2\overline{)6}$	$6\overline{)30}$	$3\overline{)15}$
$7\overline{)7}$	$8\overline{)24}$	$1\overline{)5}$	$3\overline{)3}$	$5\overline{)40}$	$9\overline{)72}$	$7\overline{)21}$	$4\overline{)28}$	$7\overline{)42}$
$3\overline{)18}$	$2\overline{)14}$	$9\overline{)9}$	$4\overline{)4}$	$5\overline{)20}$	$2\overline{)4}$	$3\overline{)6}$	$8\overline{)64}$	$1\overline{)8}$
$5\overline{)10}$	$7\overline{)63}$	$1\overline{)3}$	$5\overline{)15}$	$4\overline{)8}$	$3\overline{)9}$	$8\overline{)72}$	$4\overline{)24}$	$6\overline{)36}$
$9\overline{)18}$	$3\overline{)21}$	$4\overline{)20}$	$7\overline{)56}$	$1\overline{)9}$	$2\overline{)10}$	$6\overline{)42}$	$8\overline{)56}$	$3\overline{)24}$
$1\overline{)2}$	$2\overline{)12}$	$9\overline{)27}$	$6\overline{)54}$	$8\overline{)40}$	$6\overline{)48}$	$7\overline{)49}$	$9\overline{)54}$	$8\overline{)48}$
$5\overline{)5}$	$4\overline{)16}$	$1\overline{)6}$	$3\overline{)12}$	$9\overline{)36}$	$3\overline{)27}$	$8\overline{)32}$	$9\overline{)45}$	$5\overline{)45}$

To find how many miles a car will go per gallon of gasoline, divide the number of miles driven by the number of gallons of gasoline used.

INTERN

Dividing by a One-Place Number

Examples:

(*A*)	(*B*)	(*C*)
$\begin{array}{r} 26 \text{ Answer} \\ 3\overline{)78} \\ \underline{6} \\ 18 \\ \underline{18} \\ 0 \end{array}$	$\begin{array}{r} 49 \text{ Answer} \\ 3\overline{)147} \\ \underline{12} \\ 27 \\ \underline{27} \\ 0 \end{array}$	$\begin{array}{r} 71 \text{ Answer} \\ 3\overline{)213} \\ \underline{21} \\ 03 \\ \underline{3} \\ 0 \end{array}$

(1) Ask yourself how many times the divisor is contained in the one or two figures of the dividend nearest to it. Write the answer above the dividend.

In Example A, 3 is contained in seven 2 times
In Example B, 3 is contained in fourteen 4 times
In Example C, 3 is contained in twenty-one 7 times

(2) Multiply the number you have written by the divisor. Write the product below the dividend. Subtract the product from the number above it.

In Example A, $2 \times 3 = 6$; the difference is 1
In Example B, $4 \times 3 = 12$; the difference is 2
In Example C, $7 \times 3 = 21$; the difference is 0

(3) Write the next figure to the right in the dividend next to the difference. Ask yourself how many times the divisor is contained in the number you now have. Write the answer to your question above the dividend, to the right of the figure that is already there.

In Example A, 3 is contained in 18 six times
In Example B, 3 is contained in 27 nine times
In Example C, 3 is contained in 3 once

(4) Multiply the figure just written by the divisor and put the product below the dividend. Subtract the product from the number above it.

In Example A, $6 \times 3 = 18$; the difference is 0
In Example B, $9 \times 3 = 27$; the difference is 0
In Example C, $1 \times 3 = 3$; the difference is 0

(5) Check your work by multiplying the quotient by the divisor.

(*A*)	(*B*)	(*C*)
$\begin{array}{r} 26 \\ \times\ 3 \\ \hline 78 \end{array}$ Check	$\begin{array}{r} 49 \\ \times\ 3 \\ \hline 147 \end{array}$ Check	$\begin{array}{r} 71 \\ \times\ 3 \\ \hline 213 \end{array}$ Check

PRACTICE

In each case find the quotient and check it by multiplication.

1) 3)93	**6)** 3)246	**11)** 6)546	**16)** 4)16[illegible]4
2) 2)86	**7)** 9)729	**12)** 5)205	**17)** 8)32[illegible]
3) 7)497	**8)** 4)884	**13)** 4)288	**18)** 6)49[illegible]6
4) 8)488	**9)** 2)184	**14)** 5)155	**19)** 9)199[illegible]
5) 6)186	**10)** 3)123	**15)** 6)444	**20)** 7)5075

When the Quotient Is Not a Whole Number

Example: Divide 57 by 5.

(1) Divide as usual. Place the remainder over the divisor and write the fraction next to the figures above the dividend. The answer is a *mixed number.*

$$\begin{array}{r} 11\frac{2}{5} \\ 5\overline{)57} \\ \underline{5} \\ 7 \\ \underline{5} \\ 2 \end{array}\quad \text{Answer}$$

(2) Check by multiplying the quotient by the divisor and adding the remainder to the product.

$$\begin{array}{r} 11 \\ \times\ 5 \\ \hline 55 \\ +\ 2 \\ \hline 57 \end{array}\quad \text{Check}$$

PRACTICE

Express each quotient as a mixed number, and check your work.

1) $9\overline{)379}$	6) $9\overline{)196}$	11) $7\overline{)4558}$	16) $5\overline{)73}$
2) $2\overline{)107}$	7) $3\overline{)967}$	12) $9\overline{)1223}$	17) $6\overline{)851}$
3) $5\overline{)409}$	8) $6\overline{)675}$	13) $7\overline{)2309}$	18) $7\overline{)1471}$
4) $6\overline{)129}$	9) $5\overline{)489}$	14) $2\overline{)1907}$	19) $5\overline{)7523}$
5) $8\overline{)249}$	10) $6\overline{)536}$	15) $8\overline{)2489}$	20) $6\overline{)6946}$

Divisors Greater Than Ten

Examples: (*A*) (*B*) (*C*)

$$\begin{array}{r} 24 \text{ Answer} \\ 32\overline{)768} \\ \underline{64} \\ 128 \\ \underline{128} \\ 0 \end{array} \qquad \begin{array}{r} 52 \text{ Answer} \\ 32\overline{)1664} \\ \underline{160} \\ 64 \\ \underline{64} \\ 0 \end{array} \qquad \begin{array}{r} 42 \text{ Answer} \\ 321\overline{)13482} \\ \underline{1284} \\ 642 \\ \underline{642} \\ 0 \end{array}$$

(1) Ask yourself how many times the left-hand figure of the divisor is contained in the first one or two figures of the dividend. Write the answer above the dividend.

In Example A, 3 is contained in seven 2 times
In Example B, 3 is contained in sixteen 5 times
In Example C, 3 is contained in thirteen 4 times

(2) Multiply the number you have written by the entire divisor. Write the product below the dividend. Subtract the product from the number above it.

In Example A, $2 \times 32 = 64$; the difference is 12
In Example B, $5 \times 32 = 160$; the difference is 6
In Example C, $4 \times 321 = 1284$; the difference is 64

(3) Write the next figure to the right in the dividend next to the difference, and proceed as before.

(4) Check your work by finding the product of the quotient and the divisor.

PRACTICE

Find the quotients and check by multiplying.

1) $21\overline{)672}$
2) $32\overline{)864}$
3) $41\overline{)902}$
4) $22\overline{)726}$
5) $42\overline{)882}$
6) $33\overline{)1089}$
7) $43\overline{)946}$
8) $24\overline{)984}$
9) $23\overline{)943}$
10) $32\overline{)651}$
11) $47\overline{)988}$
12) $27\overline{)597}$
13) $49\overline{)589}$
14) $36\overline{)7982}$
15) $55\overline{)3460}$
16) $262\overline{)3406}$
17) $393\overline{)8253}$
18) $372\overline{)7812}$
19) $926\overline{)31484}$
20) $886\overline{)46,072}$

Zero in the Quotient

Example: Divide 8235 by 27.

(1) Begin the division as usual.

$$\begin{array}{r} 3 \\ 27\overline{)8235} \\ \underline{81} \\ 13 \end{array}$$

The divisor is not contained in 13; so put a zero above the dividend. Write 5 to the right of 13; that is, "bring down" 5.

$$\begin{array}{r} 30 \\ 27\overline{)8235} \\ \underline{81} \\ 135 \end{array}$$

(2) Complete the division as usual.

$$\begin{array}{r} 305 \quad \text{Answer} \\ 27\overline{)8235} \\ \underline{81} \\ 135 \\ \underline{135} \\ 0 \end{array}$$

(3) Check your work by multiplication.

PRACTICE

Divide and check by multiplication.

1) $42\overline{)5460}$
2) $56\overline{)11{,}424}$
3) $66\overline{)53{,}130}$
4) $78\overline{)47{,}048}$
5) $98\overline{)78{,}427}$
6) $45\overline{)10{,}800}$
7) $62\overline{)19{,}840}$
8) $58\overline{)58{,}232}$
9) $89\overline{)98{,}057}$
10) $66\overline{)28{,}385}$
11) $37\overline{)15{,}022}$
12) $39\overline{)7998}$
13) $36\overline{)144{,}324}$
14) $84\overline{)42{,}015}$
15) $92\overline{)33{,}120}$
16) $53\overline{)5724}$
17) $78\overline{)8112}$
18) $86\overline{)172{,}258}$
19) $75\overline{)39{,}750}$
20) $36\overline{)10{,}805}$

Rounding Off Whole Numbers

Large numbers are often rounded off. For example, the speed of light is 186,273 miles per second, but this speed is usually given as 186,000 miles per second. The more exact number is rounded off to *three-figure* accuracy. The round number is easier to remember, and is accurate enough for most purposes.

When you are working with numbers, round them off to the accuracy you need. What this accuracy is depends on your purpose. Suppose you want to give someone the idea that Mount McKinley in Alaska is much higher than Mount Washington in New Hampshire. Mount McKinley is 20,300 feet high and Mount Washington is 6293 feet high; but it would be enough to give the heights as 20,000 feet and 6000 feet. These heights are accurate to the nearest thousand feet.

If you wanted to tell someone about how far it is from Lexington, Kentucky, to Montgomery, Alabama — a road distance of 507 miles — you might say that these cities are about 500 miles apart. But suppose you wanted to compare this distance with the distance from Lexington to Athens, Georgia — 446 miles. Then you would probably say that Montgomery is about 510 miles from Lexington, and Athens is about 450 miles from Lexington. You would use *two-figure* accuracy, giving the distances to the nearest ten miles.

How to Round Off Numbers to a Given Accuracy

Example A: Give the mileage between Oklahoma City and Amarillo, Texas, to the nearest ten miles. Oklahoma City is 263 miles from Amarillo.

Think: Which is closer to 263 — 260 or 270?
The answer is 260 miles.

Example B: Round off 1087 to three-figure accuracy.

Think: Which is closer to 1087 — 1080 or 1090?
The answer is 1090.

Example C: Round off 1150 to two-figure accuracy.

Think: Which is closer to 1150 — 1100 or 1200?
Neither is. In a case like this, write the larger figure: 1200.

PRACTICE

Give each of the following to the accuracy indicated:

1. The weight of the largest bluefin caught with rod and reel — 927 pounds — to the nearest ten pounds.

2. The highway distance from Minneapolis to Des Moines — 264 miles — to two-figure accuracy.

3. The length of the Mississippi-Missouri River system — 3988 miles —

a. to the nearest ten miles
b. to the nearest hundred miles
c. to the nearest thousand miles
d. to three-figure accuracy

4. The area of Brazil — 3,279,799 square miles —

a. to the nearest hundred square miles
b. to the nearest thousand square miles
c. to the nearest ten thousand square miles
d. to the nearest hundred thousand square miles

5. The population of New York City — 7,454,996 —

a. to the nearest hundred
b. to the nearest thousand
c. to the nearest ten thousand
d. to the nearest hundred thousand

6. These sums to three-figure accuracy:

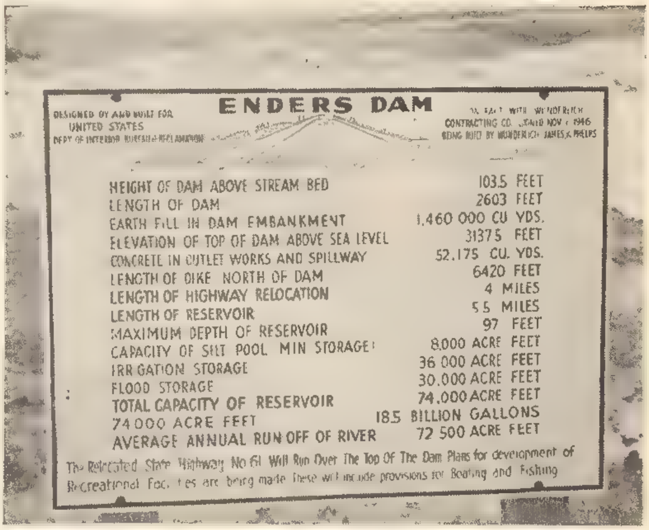
a. 83,071 + 52,516
b. 11,604 + 18,196
c. 15,245 + 6,773
d. 230,983 + 18,618

7. These differences to three-figure accuracy:

a. 68,786 − 9,289
b. 99,296 − 29,662
c. 82,810 − 32,843
d. 249,008 − 102,156

8. These products to four-figure accuracy:

a. 4 × 55,557
b. 7 × 74,496
c. 3 × 40,676



GENDREAU

Numerical facts appear on this highway sign. Notice the accuracy to which each whole number is expressed.

9. These products to two-figure accuracy:

a. 15 × 23
b. 79 × 27
c. 64 × 31
d. 46 × 58

10. These quotients to two-figure accuracy:

a. $9\overline{)2403}$
b. $7\overline{)1222}$
c. $37\overline{)27934}$
d. $42\overline{)85302}$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UNDERSTANDING COMMON FRACTIONS

The ruler pictured in Figure 2–2 has eight equal parts to the inch. Any one of these parts is one eighth of an inch. One eighth is written $\frac{1}{8}$. A number such as $\frac{1}{8}$ is called a common fraction, or just a fraction.

Every fraction has two *terms,* the numerator and the denominator. The *denominator* tells how many equal parts there are in a whole. The *numerator* tells how many of these parts are being considered.

$$\left.\begin{array}{ll} 1 & \text{NUMERATOR} \\ \hline 8 & \text{DENOMINATOR} \end{array}\right\} \text{TERMS}$$

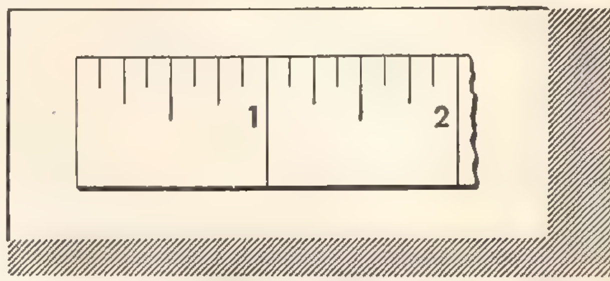


Figure 2–2

Like many fractions, $\frac{1}{8}$ has a value less than 1. But a fraction may have a value equal to 1. As Figure 2–2 shows, $\frac{8}{8}$ is equal to 1. A fraction may also have a value greater than 1.

A fraction with a value less than 1 is called a *proper* fraction. The numerator of a proper fraction is always smaller than its denominator. A fraction with a value equal to 1 or greater than 1 is called an *improper* fraction. The numerator of an improper fraction is either equal to or greater than its denominator.

$\frac{7}{8}$ is a proper fraction; its value is less than 1
$\frac{8}{8}$ is an improper fraction; its value is equal to 1
$\frac{9}{8}$ is an improper fraction; its value is greater than 1

The number $\frac{9}{8}$ is equal to 1 plus $\frac{1}{8}$, and may be written $1\frac{1}{8}$. A number such as $1\frac{1}{8}$ is called a mixed number. A mixed number is made up of a whole number and a proper fraction.

As you can see from Figure 2-2, 2 eighths are equal to 1 fourth. The fractions $\frac{2}{8}$ and $\frac{1}{4}$ are *equivalent;* that is, they are equal in value.

PRACTICE

1. Name the two terms of any fraction.
2. What is the meaning of the denominator of a fraction?
3. What is the meaning of the numerator of a fraction?
4. Identify each of these fractions as proper or improper:

a. $\frac{5}{8}$	d. $\frac{2}{3}$	g. $\frac{4}{1}$	j. $\frac{7}{10}$
b. $\frac{7}{8}$	e. $\frac{4}{3}$	h. $\frac{22}{7}$	k. $\frac{125}{100}$
c. $\frac{8}{7}$	f. $\frac{16}{16}$	i. $\frac{3}{4}$	l. $\frac{100}{100}$

5. Write all the proper fractions with the denominator 8.

6. Write five improper fractions, each with the denominator 4.

7. Express each of the following fractions as a whole number or a mixed number:

a. $\frac{2}{2}$	c. $\frac{4}{4}$	e. $\frac{32}{32}$	g. $\frac{4}{3}$
b. $\frac{3}{3}$	d. $\frac{16}{16}$	f. $\frac{3}{2}$	h. $\frac{5}{4}$

8. Write the mixed numbers with the following meanings:

a. $1 + \frac{7}{8}$	d. $99 + \frac{7}{10}$	g. $9 + \frac{1}{4}$
b. $3 + \frac{1}{2}$	e. $3 + \frac{1}{7}$	h. $83 + \frac{1}{3}$
c. $17 + \frac{2}{3}$	f. $2 + \frac{5}{16}$	i. $66 + \frac{2}{3}$

9. Tell whether the following pairs of fractions are equivalent or not. (See Figure 2–2.)

a. $\frac{1}{2}, \frac{4}{8}$	d. $\frac{3}{8}, \frac{3}{4}$	g. $\frac{3}{2}, \frac{10}{8}$
b. $\frac{2}{4}, \frac{4}{8}$	e. $\frac{4}{4}, \frac{2}{2}$	h. $\frac{12}{8}, \frac{6}{4}$
c. $\frac{3}{4}, \frac{6}{8}$	f. $\frac{4}{2}, \frac{16}{8}$	i. $\frac{8}{4}, \frac{4}{2}$

10. How are proper and improper fractions different?

Raising the Terms of Fractions

The terms of the fraction $\frac{2}{8}$ are higher than those of the equivalent fraction $\frac{1}{4}$; that is, the numerator 2 is greater than the numerator 1, and the denominator 8 is greater than the denominator 4. Any fraction — proper or improper — can be changed to an equivalent fraction with higher terms by multiplying both the numerator and the denominator by the same number.

$$\frac{1 \times 2}{4 \times 2} = \frac{2}{8}$$

Raising Fractions

Example A: Change $\frac{3}{4}$ to a fraction with a denominator of 20.

Ask yourself how many times the original denominator is contained in the new denominator. Think: 4 is contained in 20 five times.

Multiply both the numerator and the denominator of the original fraction by your answer.

$$\frac{3 \times 5}{4 \times 5} = \frac{15}{20} \quad \text{Answer}$$

The ability to work accurately with fractions is necessary in map-making.

MONKMEYER

Example B: Change $\frac{5}{8}$ to a fraction with a numerator of 30.

Ask yourself how many times the original numerator is contained in the new numerator. Think: 5 is contained in 30 six times.

Multiply both the numerator and the denominator of the original fraction by your answer.

$$\frac{5 \times 6}{8 \times 6} = \frac{30}{48} \quad \text{Answer}$$

PRACTICE

Supply the missing term in each case.

1) $\frac{7}{8} = \frac{?}{16}$
2) $\frac{1}{2} = \frac{?}{10}$
3) $\frac{2}{3} = \frac{?}{12}$
4) $\frac{7}{16} = \frac{?}{64}$
5) $\frac{9}{10} = \frac{?}{100}$
6) $\frac{1}{6} = \frac{5}{?}$
7) $\frac{2}{3} = \frac{10}{?}$
8) $\frac{3}{4} = \frac{9}{?}$
9) $\frac{3}{8} = \frac{12}{?}$
10) $\frac{5}{16} = \frac{15}{?}$
11) $\frac{9}{8} = \frac{?}{16}$
12) $\frac{7}{6} = \frac{?}{12}$
13) $\frac{7}{5} = \frac{?}{10}$
14) $\frac{9}{4} = \frac{?}{100}$
15) $\frac{25}{20} = \frac{?}{100}$
16) $\frac{1}{4} = \frac{?}{100}$
17) $\frac{2}{5} = \frac{?}{100}$
18) $\frac{9}{2} = \frac{36}{?}$
19) $\frac{5}{4} = \frac{125}{?}$
20) $\frac{15}{2} = \frac{75}{?}$
21) $\frac{5}{8} = \frac{10}{?}$
22) $\frac{1}{3} = \frac{3}{?}$
23) $\frac{9}{16} = \frac{36}{?}$
24) $\frac{4}{3} = \frac{?}{45}$
25) $\frac{19}{16} = \frac{?}{64}$
26) $\frac{13}{8} = \frac{?}{40}$
27) $\frac{5}{6} = \frac{?}{24}$
28) $\frac{1}{5} = \frac{?}{100}$
29) $\frac{3}{20} = \frac{15}{?}$
30) $\frac{9}{25} = \frac{36}{?}$

Changing a Whole Number to an Improper Fraction

Example: Change 6 to an improper fraction with 8 as the denominator.

(1) Express the whole number as a fraction with the denominator 1.

$$6 = \frac{6}{1}$$

(2) Change the fraction you now have to a fraction with the given denominator. Think: 1 is contained in 8 eight times. Multiply both the numerator and denominator by 8.

$$\frac{6 \times 8}{1 \times 8} = \frac{48}{8} \quad \textbf{Answer}$$

PRACTICE

Supply the missing numerator in each of the following.

1) $4 = \frac{?}{2}$
2) $7 = \frac{?}{4}$
3) $2 = \frac{?}{32}$
4) $10 = \frac{?}{2}$
5) $8 = \frac{?}{10}$
6) $2 = \frac{?}{16}$
7) $4 = \frac{?}{8}$
8) $3 = \frac{?}{10}$
9) $15 = \frac{?}{3}$
10) $8 = \frac{?}{7}$
11) $3 = \frac{?}{3}$
12) $5 = \frac{?}{5}$
13) $1 = \frac{?}{4}$
14) $8 = \frac{?}{8}$
15) $6 = \frac{?}{16}$
16) $1 = \frac{?}{6}$
17) $5 = \frac{?}{10}$
18) $6 = \frac{?}{36}$
19) $10 = \frac{?}{10}$
20) $9 = \frac{?}{100}$
21) $7 = \frac{?}{64}$
22) $11 = \frac{?}{12}$
23) $9 = \frac{?}{5}$
24) $12 = \frac{?}{6}$
25) $3 = \frac{?}{25}$
26) $2 = \frac{?}{100}$
27) $11 = \frac{?}{10}$
28) $6 = \frac{?}{7}$
29) $13 = \frac{?}{32}$
30) $14 = \frac{?}{50}$

Lowering the Terms of Fractions

Many times a fraction can be changed to an equivalent fraction with lower terms, or reduced. The process is just the opposite of raising a fraction to one with higher terms; that is, divide both numerator and denominator by the same number.

$$\frac{2 \div 2}{8 \div 2} = \frac{1}{4}$$

Usually you want to reduce a fraction to its lowest terms. Then you divide both numerator and denominator by the largest divisor contained evenly in both of them.

Reducing Fractions

Example: Reduce $\frac{6}{8}$ to fourths.

Think how many times the new denominator, 4, is contained in the original denominator, 8. Because 4 is contained in 8 twice, divide both the numerator and the denominator of the original fraction by 2.

$$\frac{6 \div 2}{8 \div 2} = \frac{3}{4} \quad \text{Answer}$$

PRACTICE

Supply the missing term in each case.

1) $\frac{8}{32} = \frac{?}{4}$	6) $\frac{8}{10} = \frac{4}{?}$	11) $\frac{32}{14} = \frac{16}{?}$	16) $\frac{64}{18} = \frac{?}{9}$
2) $\frac{8}{16} = \frac{?}{4}$	7) $\frac{16}{32} = \frac{4}{?}$	12) $\frac{64}{30} = \frac{32}{?}$	17) $\frac{10}{2\text{[illegible]}} = \frac{?}{5}$
3) $\frac{60}{100} = \frac{?}{5}$	8) $\frac{12}{14} = \frac{6}{?}$	13) $\frac{6}{8} = \frac{?}{4}$	18) $\frac{2\text{[illegible]}}{10\text{[illegible]}} = \frac{1}{?}$
4) $\frac{75}{100} = \frac{?}{4}$	9) $\frac{80}{100} = \frac{?}{5}$	14) $\frac{8}{20} = \frac{?}{5}$	19) $\frac{16}{24} = \frac{2}{?}$
5) $\frac{24}{36} = \frac{?}{6}$	10) $\frac{50}{100} = \frac{?}{2}$	15) $\frac{32}{16} = \frac{4}{?}$	20) $\frac{12}{9} = \frac{?}{3}$

Reducing to Lowest Terms

Example: Reduce $\frac{16}{24}$ to lowest terms.

(1) Ask yourself what numbers you would multiply together to get the numerator. Think: $2 \times 8 = 16$; $4 \times 4 = 16$.

(2) Ask yourself what numbers you would multiply together to get the denominator. Think: $2 \times 12 = 24$; $3 \times 8 = 24$; $4 \times 6 = 24$.

(3) Select the largest number which can be divided evenly into both the numerator and the denominator. In this case, the number is 8. Divide both terms by 8.

$$\frac{16 \div 8}{24 \div 8} = \frac{2}{3} \quad \text{Answer}$$

PRACTICE

Reduce each of the following fractions to lowest terms.

1) $\frac{2}{4}$	8) $\frac{24}{9}$	15) $\frac{8}{48}$
2) $\frac{3}{9}$	9) $\frac{48}{16}$	16) $\frac{8}{12}$
3) $\frac{4}{8}$	10) $\frac{21}{14}$	17) $\frac{14}{16}$
4) $\frac{5}{10}$	11) $\frac{20}{32}$	18) $\frac{15}{50}$
5) $\frac{8}{24}$	12) $\frac{22}{32}$	19) $\frac{20}{25}$
6) $\frac{10}{4}$	13) $\frac{8}{32}$	20) $\frac{75}{100}$
7) $\frac{6}{4}$	14) $\frac{16}{100}$	

A Short Way to Reduce an Improper Fraction

Example A: Change $\frac{32}{8}$ to a whole number.

Divide the numerator by the denominator:

$$8\overline{)32} = 4 \quad \text{Answer}$$

Example B: Change $\frac{20}{8}$ to a mixed number.

(1) Divide the numerator by the denominator.

$$\begin{array}{r} 2 \\ 8\overline{)20} \\ \underline{16} \\ 4 \end{array}$$

(2) Write the remainder as the numerator of a fraction having the divisor as the denominator. Reduce this fraction to its lowest terms.

$$\frac{4}{8} = \frac{1}{2}$$

(3) Express the quotient as a mixed number.

$$\frac{20}{8} = 2\frac{1}{2} \quad \text{Answer}$$

PRACTICE

Change each of the following to a whole number or to a mixed number.

1) $\frac{8}{8}$	6) $\frac{10}{10}$	11) $\frac{28}{24}$	16) $\frac{16}{8}$
2) $\frac{9}{4}$	7) $\frac{22}{7}$	12) $\frac{15}{10}$	17) $\frac{17}{6}$
3) $\frac{12}{6}$	8) $\frac{14}{5}$	13) $\frac{125}{100}$	18) $\frac{33}{16}$
4) $\frac{5}{3}$	9) $\frac{36}{2}$	14) $\frac{13}{8}$	19) $\frac{23}{20}$
5) $\frac{11}{4}$	10) $\frac{13}{12}$	15) $\frac{21}{3}$	20) $\frac{19}{16}$

Addition of Fractions

Fractions that have the same denominator are called *like fractions* (or similar fractions). The denominator of like fractions is called the *common denominator.* Fractions that have different denominators are called *unlike fractions.*

Like fractions:
$\frac{3}{5}, \frac{5}{5}, \frac{7}{5}, \frac{9}{5}, \frac{12}{5}$

Unlike fractions:
$\frac{1}{4}, \frac{7}{8}, \frac{3}{3}, \frac{13}{10}, \frac{8}{25}, \frac{67}{100}$

Anyone who works with scale drawings needs to be able to add fractions quickly and correctly.

BLACK STAR

Adding Like Fractions

Like fractions are added just as any other like quantities are:

3 fifths + 1 fifth = 4 fifths
$\frac{3}{5} + \frac{1}{5} = \frac{4}{5}$

1 third + 4 thirds = 5 thirds
$\frac{1}{3} + \frac{4}{3} = \frac{5}{3}$

A sum should be given in its lowest terms. If the sum is an improper fraction, it should be changed to a mixed number.

Example: Add $\frac{5}{8}$ and $\frac{7}{8}$.

(1) Add the numerators; write the sum over the common denominator:

$$\frac{5}{8}+\frac{7}{8}=\frac{12}{8}$$

(2) Reduce the sum to lowest terms:

$$\frac{12}{8}=\frac{3}{2}$$

(3) Change the improper fraction to a mixed number:

$$\frac{3}{2}=1\frac{1}{2} \quad \text{Answer}$$

PRACTICE

Find the sums, giving each in its lowest terms. Express improper fractions as mixed numbers.

1) $\frac{1}{4}+\frac{1}{4}$

2) $\frac{3}{12}+\frac{3}{12}$

3) $\frac{7}{24}+\frac{3}{24}$

4) $\frac{9}{16}+\frac{1}{16}$

5) $\frac{1}{10}+\frac{7}{10}$

6) $\frac{1}{24}+\frac{7}{24}$

7) $\frac{11}{16}+\frac{3}{16}$

8) $\frac{9}{20}+\frac{9}{20}$

9) $\frac{3}{8}+\frac{3}{8}$

10) $\frac{3}{6}+\frac{1}{6}$

11) $\frac{11}{24}+\frac{23}{24}$

12) $\frac{9}{16}+\frac{11}{16}$

13) $\frac{7}{20}+\frac{17}{20}$

14) $\frac{5}{8}+\frac{7}{8}$

15) $\frac{7}{10}+\frac{7}{10}$

16) $\frac{3}{10}+\frac{5}{10}+\frac{7}{10}$

17) $\frac{7}{16}+\frac{5}{16}+\frac{9}{16}$

18) $\frac{5}{12}+\frac{11}{12}+\frac{1}{12}$

19) $\frac{13}{16}+\frac{15}{16}+\frac{3}{16}$

20) $\frac{1}{5}+\frac{2}{5}+\frac{3}{5}+\frac{7}{5}$

Adding Unlike Fractions

To add unlike fractions, first change them to equivalent fractions with the *smallest* common denominator you can find.

Example A: Find the sum of $\frac{1}{4}$ and $\frac{3}{8}$.

(1) To find a common denominator, compare the denominators of the addends. Think: 4 can be divided into 8; so 8 can be used as a common denominator.

(2) Change the addends to equivalent fractions with a common denominator; then add the like fractions that result.

$$\begin{array}{r} \frac{1}{4} = \frac{2}{8} \\ \frac{3}{8} = \frac{3}{8} \\ \hline \frac{5}{8} \end{array} \quad \text{Answer}$$

Example B: Find the sum of $\frac{1}{2}$ and $\frac{4}{5}$.

(1) Compare the denominators of the addends. Since the smaller will not divide evenly into the larger, multiply the denominators to find a common denominator.

Think: $2 \times 5 = 10$.

(2) Change the addends to equivalent fractions with a common denominator; then add the like fractions that result.

$$\begin{array}{r} \frac{1}{2} = \frac{5}{10} \\ \frac{4}{5} = \frac{8}{10} \\ \hline \frac{13}{10} = 1\frac{3}{10} \end{array} \quad \text{Answer}$$

Example C: Find the sum of $\frac{3}{8}$ and $\frac{5}{6}$.

(1) Ask yourself whether there is any number which can be divided evenly into both denominators.

Think: $8 \div 2 = 4$ and $6 \div 2 = 3$.

(2) Multiply this divisor by both quotients.

Think: $2 \times 4 \times 3 = 24$.

(3) Use the product as the common denominator, and proceed as in Examples *A* and *B*.

$$\begin{array}{r} \frac{3}{8} = \frac{9}{24} \\ \frac{5}{6} = \frac{20}{24} \\ \hline \frac{29}{24} = 1\frac{5}{24} \end{array} \quad \text{Answer}$$

PRACTICE

Give each sum in its lowest terms.

1) $\frac{1}{2} + \frac{1}{4}$	11) $\frac{3}{4} + \frac{1}{10}$	21) $\frac{1}{4} + \frac{3}{12}$
2) $\frac{1}{3} + \frac{5}{12}$	12) $\frac{3}{10} + \frac{1}{8}$	22) $\frac{9}{16} + \frac{7}{24}$
3) $\frac{7}{16} + \frac{1}{4}$	13) $\frac{7}{10} + \frac{5}{12}$	23) $\frac{1}{10} + \frac{1}{24}$
4) $\frac{1}{2} + \frac{2}{5}$	14) $\frac{3}{10} + \frac{2}{3}$	24) $\frac{11}{16} + \frac{9}{20}$
5) $\frac{3}{8} + \frac{1}{2}$	15) $\frac{9}{16} + \frac{1}{5}$	25) $\frac{3}{8} + \frac{3}{6}$
6) $\frac{3}{4} + \frac{1}{8}$	16) $\frac{1}{10} + \frac{1}{2} + \frac{2}{5}$	26) $\frac{5}{8} + \frac{7}{10}$
7) $\frac{3}{10} + \frac{1}{2}$	17) $\frac{1}{3} + \frac{5}{6} + \frac{1}{2}$	27) $\frac{3}{10} + \frac{7}{16}$
8) $\frac{1}{2} + \frac{1}{12}$	18) $\frac{7}{16} + \frac{3}{8} + \frac{1}{2}$	28) $\frac{5}{12} + \frac{13}{16}$
9) $\frac{1}{6} + \frac{1}{3}$	19) $\frac{7}{12} + \frac{1}{4} + \frac{1}{6}$	29) $\frac{7}{5} + \frac{3}{12}$
10) $\frac{2}{5} + \frac{1}{4}$	20) $\frac{1}{3} + \frac{3}{4} + \frac{5}{6}$	30) $\frac{7}{10} + \frac{3}{32}$

Adding Mixed Numbers

You can use either of two methods to add mixed numbers. Both procedures are shown in the following example.

Example: Find the sum of $2\frac{7}{8}$ and $4\frac{1}{2}$.

(1) Consider the fractional parts of the addends. Since they are unlike fractions, change them to equivalent fractions with a common denominator. Then add the like fractions that result.

$$\begin{array}{rl} \frac{7}{8} = & \frac{7}{8} \\ \frac{1}{2} = & \frac{4}{8} \\ \hline & \frac{11}{8} = 1\frac{3}{8} \end{array}$$

(2) Consider the whole-number parts of the addends. Add them.

$$2 + 4 = 6$$

(3) Add the two sums you now have.

$$1\tfrac{3}{8} + 6 = 7\tfrac{3}{8} \quad \text{Answer}$$

Another way to add mixed numbers is as follows:

(1) Write the addends in columns. Change them to equivalent mixed numbers whose fractional parts have a common denominator.

$$\begin{aligned} 2\tfrac{7}{8} &= 2\tfrac{7}{8} \\ 4\tfrac{1}{2} &= \underline{4\tfrac{4}{8}} \end{aligned}$$

(2) Add the column of like fractions. Change the sum to a mixed number. Write the fractional part beneath the fraction column. Carry the whole-number part. Add the column of whole numbers. Write the sum beneath the whole-number column. Your work will look like this:

$$\begin{array}{l} \scriptstyle 1 \\ 2\tfrac{7}{8} \\ \underline{4\tfrac{4}{8}} \\ 7\tfrac{3}{8} \quad \text{Answer} \end{array}$$

PRACTICE

Use the procedure you prefer to find the following sums, giving each fraction in its lowest terms.

1) $3\frac{1}{4} + 7\frac{1}{4}$
2) $1\frac{3}{4} + 3\frac{3}{4}$
3) $14\frac{4}{5} + 22\frac{3}{5}$
4) $10\frac{7}{10} + 8\frac{9}{10}$
5) $14\frac{5}{16} + 16\frac{7}{16}$
6) $3\frac{1}{2} + 5\frac{1}{15}$
7) $3\frac{1}{4} + 7\frac{1}{5}$
8) $6\frac{2}{5} + 4\frac{2}{3}$
9) $7\frac{1}{2} + 3\frac{2}{3}$
10) $12\frac{7}{10} + 33\frac{1}{2}$

11) $6\frac{2}{3} + 2\frac{1}{3}$

12) $5\frac{3}{8} + 6\frac{5}{8}$

13) $6\frac{1}{8} + 3\frac{5}{8} + 5\frac{7}{8}$

14) $6\frac{3}{5} + 4\frac{2}{5} + 7\frac{4}{5}$

15) $4\frac{1}{4} + 3\frac{1}{4} + 5\frac{3}{4}$

16) $6\frac{1}{6} + 2\frac{5}{8} + 7\frac{2}{3}$

17) $9\frac{2}{3} + 8\frac{5}{12} + 10\frac{1}{4}$

18) $3\frac{1}{3} + 7\frac{1}{2} + 8\frac{1}{4}$

19) $5\frac{3}{4} + 2\frac{2}{3} + 6\frac{1}{2}$

20) $4\frac{7}{16} + 5\frac{3}{8} + 9\frac{1}{4}$

Changing Mixed Numbers to Improper Fractions

Example: Change $4\frac{1}{3}$ to an improper fraction.

(1) Express the mixed number as the sum of a whole number and a proper fraction.

$$4\tfrac{1}{3} = 4 + \tfrac{1}{3}$$

(2) Change the whole number to an improper fraction with the denominator of the proper fraction.

$$4 = \frac{4}{1} \qquad \frac{4 \times 3}{1 \times 3} = \frac{12}{3}$$

(3) Add the improper fraction and the proper fraction.

$$\tfrac{12}{3} + \tfrac{1}{3} = \tfrac{13}{3} \quad \text{Answer}$$

PRACTICE

Express each mixed number as an improper fraction.

1) $2\frac{1}{2}$

2) $5\frac{1}{3}$

3) $4\frac{1}{2}$

4) $2\frac{2}{3}$

5) $6\frac{1}{4}$

6) $2\frac{4}{5}$

7) $5\frac{3}{8}$

8) $8\frac{2}{3}$

9) $3\frac{15}{16}$

10) $5\frac{5}{10}$

11) $7\frac{13}{16}$

12) $10\frac{3}{10}$

13) $9\frac{15}{32}$

14) $3\frac{1}{7}$

15) $11\frac{1}{8}$

16) $8\frac{8}{25}$

17) $15\frac{1}{4}$

18) $12\frac{1}{6}$

19) $13\frac{37}{100}$

20) $10\frac{31}{32}$

Subtraction of Fractions

Like fractions are subtracted just as any other quantities are. Unlike fractions must be changed to equivalent fractions with a common denominator before they can be subtracted.

Subtracting Proper and Improper Fractions

Example A: Find this difference: $\frac{5}{8} - \frac{1}{8}$.

Subtract the numerators; place the difference over the common denominator, and reduce the resulting fraction to lowest terms:

$$\frac{5}{8} - \frac{1}{8} = \frac{4}{8}$$

$$\frac{4}{8} = \frac{1}{2} \quad \text{Answer}$$

Example B: Find the difference between $\frac{5}{4}$ and $\frac{2}{3}$.

Change the fractions to equivalent fractions with a common denominator, and subtract the like fractions:

$$\frac{5}{4} = \frac{15}{12}$$

$$\frac{2}{3} = \frac{8}{12}$$

$$\frac{7}{12} \quad \text{Answer}$$

PRACTICE

Subtract, giving all answers in their lowest terms.

1) $\frac{3}{16} - \frac{1}{16}$	6) $\frac{19}{16} - \frac{7}{16}$	11) $\frac{9}{8} - \frac{1}{2}$	16) $\frac{2}{3} - \frac{1}{2}$
2) $\frac{5}{6} - \frac{1}{6}$	7) $\frac{1}{3} - \frac{1}{6}$	12) $\frac{3}{2} - \frac{3}{8}$	17) $\frac{9}{4} - \frac{7}{10}$
3) $\frac{4}{5} - \frac{2}{5}$	8) $\frac{3}{4} - \frac{1}{2}$	13) $\frac{1}{2} - \frac{1}{3}$	18) $\frac{3}{10} - \frac{3}{16}$
4) $\frac{11}{12} - \frac{1}{12}$	9) $\frac{5}{6} - \frac{2}{3}$	14) $\frac{5}{4} - \frac{2}{3}$	19) $\frac{5}{8} - \frac{5}{10}$
5) $\frac{11}{10} - \frac{3}{10}$	10) $\frac{1}{2} - \frac{1}{6}$	15) $\frac{2}{3} - \frac{2}{5}$	20) $\frac{7}{10} - \frac{1}{4}$

Subtracting Fractions from Whole Numbers

Example: Subtract $\frac{3}{8}$ from 5.

(1) Change the whole number to a mixed number.

Think: $5 = 4 + 1;\ 1 = \frac{8}{8}$

(2) Rewrite the problem and subtract, thus:

$$\begin{array}{r} 4\frac{8}{8} \\ -\ \frac{3}{8} \\ \hline 4\frac{5}{8} \end{array} \quad \text{Answer}$$

PRACTICE

Find each of the following differences.

1) $7 - \frac{1}{2}$	**6)** $9 - \frac{5}{6}$	**11)** $4 - \frac{1}{3}$	**16)** $8 - \frac{17}{32}$
2) $8 - \frac{4}{5}$	**7)** $3 - \frac{1}{2}$	**12)** $9 - \frac{1}{6}$	**17)** $7 - \frac{43}{64}$
3) $9 - \frac{3}{10}$	**8)** $7 - \frac{1}{5}$	**13)** $8 - \frac{3}{4}$	**18)** $10 - \frac{13}{16}$
4) $5 - \frac{11}{12}$	**9)** $5 - \frac{1}{10}$	**14)** $6 - \frac{7}{8}$	**19)** $2 - \frac{2}{3}$
5) $6 - \frac{2}{3}$	**10)** $4 - \frac{7}{12}$	**15)** $6 - \frac{2}{3}$	**20)** $5 - \frac{15}{32}$

Subtracting Mixed Numbers

Example A: Find this difference: $8\frac{1}{3} - 3\frac{2}{3}$.

(1) Compare the fractional parts of the numbers. Since $\frac{2}{3}$ is larger than $\frac{1}{3}$, you will have to borrow.

Think: $8\frac{1}{3} = 7 + 1\frac{1}{3};\ 1\frac{1}{3} = \frac{4}{3}$.

(2) Rewrite the problem and subtract; thus:

$$\begin{array}{r} 7\frac{4}{3} \\ -\ 3\frac{2}{3} \\ \hline 4\frac{2}{3} \end{array} \quad \text{Answer}$$

Example B: Find this difference: $9\frac{1}{4} - 7\frac{2}{5}$.

(1) Change the numbers to equivalent mixed numbers whose fractional parts have a common denominator

$$9\frac{1}{4} = 9\frac{5}{20}$$
$$7\frac{2}{5} = 7\frac{8}{20}$$

(2) Compare the fractional parts of the numbers.

Think: $9\frac{5}{20} = 8 + 1\frac{5}{20}$; $1\frac{5}{20} = \frac{25}{20}$.

(3) Rewrite the problem and subtract.

$$\begin{array}{r} 8\frac{25}{20} \\ -\,7\frac{8}{20} \\ \hline 1\frac{17}{20} \end{array} \quad \text{Answer}$$

PRACTICE

Find each of the following differences.

1) $13\frac{1}{5} - 4\frac{4}{5}$
2) $9\frac{1}{4} - 1\frac{3}{4}$
3) $5\frac{1}{6} - 3\frac{3}{6}$
4) $10\frac{2}{5} - 8\frac{3}{5}$
5) $16\frac{1}{8} - 8\frac{3}{8}$
6) $14\frac{3}{10} - 8\frac{9}{10}$
7) $9\frac{3}{8} - 6\frac{1}{2}$
8) $15\frac{1}{6} - 7\frac{2}{3}$
9) $18\frac{1}{2} - 9\frac{9}{10}$
10) $12\frac{1}{6} - 5\frac{1}{2}$
11) $10\frac{2}{5} - 4\frac{3}{10}$
12) $6\frac{1}{8} - 4\frac{1}{2}$
13) $4\frac{1}{3} - 2\frac{1}{2}$
14) $6\frac{2}{3} - 3\frac{3}{4}$
15) $7\frac{1}{3} - 5\frac{3}{8}$
16) $10\frac{2}{5} - 6\frac{2}{3}$
17) $12\frac{1}{2} - 8\frac{2}{3}$
18) $8\frac{1}{2} - 7\frac{3}{5}$
19) $10\frac{1}{5} - 6\frac{1}{2}$
20) $20\frac{3}{8} - 7\frac{3}{4}$
21) $10 - 6\frac{3}{4}$
22) $5 - 1\frac{2}{5}$
23) $4 - 2\frac{3}{16}$
24) $10 - 5\frac{5}{8}$
25) $4 - 2\frac{1}{4}$
26) $25 - 20\frac{1}{8}$
27) $5 - 1\frac{1}{6}$
28) $8 - 4\frac{5}{8}$
29) $5 - 4\frac{3}{4}$
30) $12 - 10\frac{4}{5}$

Multiplication of Fractions

To multiply fractions, first multiply the numerators, then multiply the denominators. To multiply fractions by mixed numbers or whole numbers, change the mixed or whole numbers to improper fractions and follow the same rule.

How to Multiply by a Fraction

Example A: Multiply $\frac{3}{4}$ by $\frac{7}{12}$.

Multiply the numerators; then multiply the denominators. Express the product in lowest terms.

$$\frac{3}{4} \times \frac{7}{12} = \frac{21}{48} \qquad \frac{21}{48} = \frac{7}{16} \quad \text{Answer}$$

Example B: Multiply 6 by $1\frac{1}{4}$.

(1) Express both the whole number and the mixed number as improper fractions.

$$6 = \frac{6}{1}$$
$$1\frac{1}{4} = \frac{5}{4}$$

(2) Multiply the numerators; then multiply the denominators. Express the product in lowest terms.

$$\frac{6}{1} \times \frac{5}{4} = \frac{30}{4} \qquad \frac{30}{4} = \frac{15}{2} = 7\frac{1}{2} \quad \text{Answer}$$

PRACTICE

Give each of the following products in its lowest terms.

1) $\frac{4}{5} \times \frac{7}{12}$
2) $\frac{2}{3} \times \frac{5}{8}$
3) $\frac{1}{3} \times \frac{3}{4}$
4) $\frac{3}{10} \times \frac{4}{5}$
5) $\frac{5}{6} \times \frac{2}{3}$
6) $\frac{4}{5} \times \frac{5}{6}$
7) $\frac{3}{16} \times \frac{9}{10}$
8) $\frac{5}{6} \times \frac{17}{20}$
9) $\frac{13}{16} \times \frac{2}{3}$
10) $\frac{8}{3} \times \frac{22}{7}$
11) $3\frac{1}{7} \times 4\frac{3}{4}$
12) $2\frac{2}{5} \times 2\frac{1}{2}$
13) $3\frac{1}{3} \times 3\frac{1}{10}$
14) $6\frac{2}{3} \times 5\frac{1}{2}$
15) $2\frac{3}{8} \times 1\frac{3}{5}$

16) $4\frac{1}{6} \times 3\frac{3}{5}$

17) $3\frac{3}{8} \times 2\frac{2}{3}$

18) $4\frac{2}{5} \times 1\frac{7}{8}$

19) $5\frac{3}{5} \times 3\frac{1}{8}$

20) $4\frac{1}{2} \times 4\frac{1}{2}$

21) $6 \times \frac{1}{2}$

22) $10 \times \frac{3}{5}$

23) $240 \times \frac{1}{5}$

24) $35 \times \frac{7}{10}$

25) $14 \times \frac{5}{16}$

26) $\frac{2}{5} \times 20$

27) $\frac{3}{4} \times 36$

28) $\frac{5}{6} \times 42$

29) $\frac{3}{10} \times 7$

30) $\frac{9}{16} \times 64$

31) $1\frac{4}{5} \times 15$

32) $3\frac{1}{3} \times 12$

33) $1\frac{5}{8} \times 12$

34) $1\frac{1}{12} \times 36$

35) $1\frac{7}{10} \times 50$

36) $5 \times 3\frac{1}{3}$

37) $16 \times 2\frac{3}{8}$

38) $7 \times 5\frac{1}{4}$

39) $12 \times 4\frac{1}{3}$

40) $16 \times 2\frac{1}{3}$

A Short Cut in Multiplying Fractions — Cancellation

Example A: Find this product: $\frac{3}{4} \times \frac{8}{15}$.

(1) See whether either numerator can be divided evenly into either denominator. Think: 3 is contained in 15 five times. Show the division thus:

$$\frac{\overset{1}{\cancel{3}}}{4} \times \frac{8}{\underset{5}{\cancel{15}}}$$

(2) See whether either denominator can be divided evenly into either numerator. Think: 4 is contained in 8 twice. Show this division also:

$$\frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{4}}} \times \frac{\overset{2}{\cancel{8}}}{\underset{5}{\cancel{15}}}$$

(3) Multiply the fractions you now have.

$$\frac{\overset{1}{\cancel{3}}}{\underset{1}{\cancel{4}}} \times \frac{\overset{2}{\cancel{8}}}{\underset{5}{\cancel{15}}} = \frac{2}{5} \quad \text{Answer}$$

GALLOWAY

Many a bride must know how fractions are multiplied when she changes a recipe serving six persons to a recipe serving two.

Example B: Find this product: $\frac{7}{12} \times \frac{8}{15}$.

Neither of the numerators divides evenly into a denominator, and neither of the denominators divides evenly into a numerator. Therefore see whether there is any number that can be divided evenly into both a numerator and a denominator. Think: 4 is contained in 8 twice; 4 is contained in 12 three times.

Show this division and complete the multiplication. Your work will look like this:

$$\frac{7}{\underset{3}{\cancel{12}}} \times \frac{\overset{2}{\cancel{8}}}{15} = \frac{14}{45} \quad \text{Answer}$$

PRACTICE

Find the following products, using cancellation when possible.

1) $\frac{3}{4} \times \frac{7}{12}$	**8)** $\frac{2}{5} \times \frac{9}{10}$	**15)** $\frac{8}{15} \times \frac{25}{32}$
2) $\frac{3}{5} \times \frac{15}{16}$	**9)** $\frac{1}{3} \times \frac{2}{3}$	**16)** $3\frac{1}{3} \times \frac{21}{100}$
3) $\frac{5}{8} \times \frac{16}{25}$	**10)** $\frac{15}{16} \times \frac{8}{9}$	**17)** $4\frac{1}{2} \times \frac{1}{3}$
4) $\frac{1}{16} \times \frac{4}{5}$	**11)** $3 \times \frac{2}{3}$	**18)** $7\frac{1}{2} \times 2\frac{2}{3}$
5) $\frac{5}{8} \times \frac{7}{10}$	**12)** $16 \times \frac{5}{64}$	**19)** $\frac{24}{25} \times \frac{7}{12}$
6) $\frac{1}{3} \times \frac{27}{32}$	**13)** $\frac{7}{10} \times 15$	**20)** $\frac{9}{10} \times \frac{1}{6}$
7) $\frac{9}{16} \times \frac{2}{3}$	**14)** $\frac{22}{7} \times 42$	

Division of Fractions

When you divide any quantity by 2, you are actually taking one half of the quantity; when you divide it by 3, you are taking one third of it; and so on.

$$2\overline{)12}^{\,6} \qquad 3\overline{)12}^{\,4} \qquad 4\overline{)12}^{\,3}$$

$$\tfrac{1}{2} \times 12 = 6 \qquad \tfrac{1}{3} \times 12 = 4 \qquad \tfrac{1}{4} \times 12 = 3$$

The fraction $\frac{1}{2}$ is called the *reciprocal* (re sip′ro k'l) of the whole number 2. Since the whole number 2 may be written $\frac{2}{1}$, the reciprocal of 2 is really the number inverted. The reciprocal of 3 is $\frac{1}{3}$; the reciprocal of 4 is $\frac{1}{4}$; and so on. Every number has its reciprocal. The reciprocal of the number $\frac{2}{3}$ is $\frac{3}{2}$; the reciprocal of $\frac{1}{5}$ is $\frac{5}{1}$, or 5.

Dividing by any number — whole number or fraction — is the same as multiplying by the reciprocal of the number.

Dividing a Fraction by a Whole Number

Example A: Find this quotient: $\frac{5}{8} \div 6$.

(1) Rewrite the problem, expressing the divisor as an improper fraction.

$$\frac{5}{8} \div \frac{6}{1}$$

(2) Think: The reciprocal of $\frac{6}{1}$ is $\frac{1}{6}$. Write the problem as one in multiplication, and multiply.

$$\frac{5}{8} \times \frac{1}{6} = \frac{5}{48} \quad \text{Answer}$$

Example B: Find this quotient: $3\frac{3}{10} \div 10$.

(1) Rewrite the problem, expressing both dividend and divisor as improper fractions.

$$\frac{33}{10} \div \frac{10}{1}$$

(2) Think: The reciprocal of $\frac{10}{1}$ is $\frac{1}{10}$. Write the problem as one in multiplication, and multiply.

$$\frac{33}{10} \times \frac{1}{10} = \frac{33}{100} \quad \text{Answer}$$

PRACTICE

Find each of the following quotients.

1) $\frac{1}{3} \div 2$
2) $\frac{2}{5} \div 8$
3) $\frac{1}{24} \div 2$
4) $\frac{13}{24} \div 13$
5) $\frac{5}{6} \div 5$
6) $\frac{1}{4} \div 6$
7) $\frac{7}{8} \div 7$
8) $\frac{7}{16} \div 21$
9) $\frac{15}{16} \div 3$
10) $\frac{2}{3} \div 6$
11) $3\frac{1}{7} \div 11$
12) $5\frac{1}{3} \div 3$
13) $5\frac{1}{4} \div 7$
14) $6\frac{1}{4} \div 5$
15) $12\frac{1}{4} \div 7$
16) $1\frac{1}{9} \div 20$
17) $2\frac{4}{5} \div 3$
18) $10\frac{1}{3} \div 2$
19) $2\frac{5}{12} \div 60$
20) $4\frac{5}{8} \div 10$
21) $\frac{1}{4} \div 4$
22) $1\frac{11}{16} \div 9$
23) $\frac{7}{8} \div 14$
24) $3\frac{3}{5} \div 15$
25) $12\frac{1}{2} \div 100$

Dividing by a Fraction

Example A: Find this quotient: $\frac{2}{3} \div \frac{3}{8}$.

Think: The reciprocal of $\frac{3}{8}$ is $\frac{8}{3}$. Write the problem as one in multiplication, and solve it.

$$\frac{2}{3} \times \frac{8}{3} = \frac{16}{9} \qquad \frac{16}{9} = 1\frac{7}{9} \quad \text{Answer}$$

Example B: Find this quotient: $7 \div 1\frac{3}{4}$.

(1) Rewrite the problem, expressing both dividend and divisor as improper fractions.

$$\frac{7}{1} \div \frac{7}{4}$$

(2) Think: The reciprocal of $\frac{7}{4}$ is $\frac{4}{7}$. Write the problem as one in multiplication, and solve it.

$$\frac{7}{1} \times \frac{4}{7} = 4 \quad \text{Answer}$$

PRACTICE

Find each of the following quotients.

1) $\frac{1}{2} \div \frac{3}{4}$

2) $\frac{5}{8} \div \frac{7}{10}$

3) $\frac{1}{4} \div \frac{1}{2}$

4) $\frac{9}{10} \div \frac{1}{6}$

5) $\frac{3}{5} \div \frac{3}{10}$

6) $\frac{1}{6} \div \frac{1}{3}$

7) $\frac{3}{5} \div \frac{7}{10}$

8) $\frac{1}{16} \div \frac{1}{8}$

9) $\frac{5}{12} \div \frac{3}{4}$

10) $\frac{1}{10} \div \frac{1}{9}$

11) $3 \div \frac{3}{4}$

12) $8 \div \frac{3}{8}$

13) $36 \div \frac{1}{3}$

14) $5 \div \frac{1}{5}$

15) $4 \div \frac{1}{2}$

16) $60 \div \frac{3}{8}$

17) $8 \div \frac{5}{16}$

18) $15 \div \frac{4}{5}$

19) $18 \div \frac{1}{4}$

20) $21 \div \frac{7}{8}$

21) $8\frac{2}{3} \div 3\frac{1}{4}$

22) $8\frac{1}{2} \div 7\frac{2}{3}$

23) $16\frac{1}{3} \div 3\frac{1}{2}$

24) $6\frac{7}{8} \div 5\frac{1}{2}$

25) $10\frac{1}{4} \div 9\frac{2}{3}$

26) $3\frac{1}{2} \div 1\frac{2}{5}$

27) $10\frac{2}{5} \div 4\frac{1}{3}$

28) $9\frac{2}{3} \div 1\frac{5}{6}$

29) $2\frac{1}{5} \div 4\frac{2}{5}$

30) $3\frac{3}{4} \div 1\frac{7}{8}$

31) $9\frac{3}{5} \div \frac{3}{10}$

32) $1\frac{1}{2} \div \frac{3}{4}$

33) $6\frac{1}{4} \div \frac{5}{12}$

34) $44 \div 2\frac{3}{4}$

35) $15 \div 1\frac{1}{4}$

36) $11 \div 3\frac{1}{7}$

37) $\frac{5}{6} \div 6\frac{2}{3}$

38) $\frac{1}{4} \div 8\frac{3}{4}$

39) $\frac{4}{5} \div 10\frac{2}{3}$

40) $\frac{5}{8} \div 7\frac{1}{2}$

41) $\frac{1}{3} \div \frac{1}{2}$

42) $\frac{2}{5} \div \frac{1}{8}$

43) $\frac{1}{24} \div \frac{1}{2}$

44) $\frac{11}{32} \div \frac{1}{32}$

45) $\frac{7}{16} \div \frac{21}{32}$

46) $9\frac{1}{2} \div 1\frac{1}{2}$

47) $1 \div \frac{1}{3}$

48) $10 \div \frac{1}{4}$

49) $99 \div 5\frac{1}{2}$

50) $66 \div \frac{22}{7}$

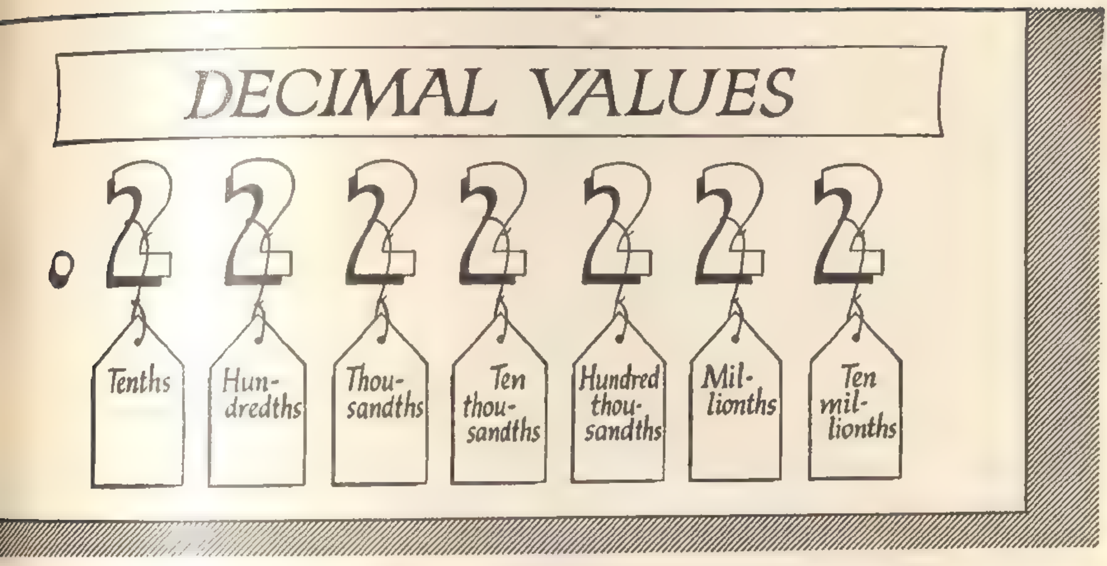


Figure 2–3

UNDERSTANDING DECIMAL FRACTIONS

A decimal fraction ("decimal" for short) is a fraction whose denominator is not written but is understood to be 10 or 10 multiplied by itself one or more times.

The denominator of a decimal fraction is indicated by a period called a *decimal point.* There are as many zeros in the denominator as there are places to the right of the decimal point. Figures to the left of it represent whole numbers.

Decimal Fraction	*Common Fraction*
.3	$\frac{3}{10}$
.21	$\frac{21}{100}$
.04	$\frac{4}{100}$
.561	$\frac{561}{1000}$
.072	$\frac{72}{1000}$
.004	$\frac{4}{1000}$
1.2	$\frac{12}{10} = 1\frac{2}{10}$
13.42	$\frac{1342}{100} = 13\frac{42}{100}$

Decimal fractions are named just as common fractions are. Thus, .3 is three tenths, and .04 is four hundredths. The name of the decimal fraction is the name of the position of the figure farthest to the right. The first place to the right represents the number of tenths; the second place represents the number of hundredths, and so on indefinitely. See Figure 2–3.

PRACTICE

Write the numbers in items 1–20 as common fractions; write the numbers in items 21–50 as decimal fractions.

1) .25
2) 1.75
3) .5
4) 3.5
5) .36
6) 4.375
7) 2.45
8) 8.013
9) .162
10) 16.204
11) 18.731
12) .981
13) 2.003
14) 9.001
15) .3075
16) .06
17) 25.004
18) .0008
19) 8.3475
20) 10.01

21) $\frac{3}{10}$
22) $\frac{27}{100}$
23) $2\frac{1}{10}$
24) $12\frac{15}{100}$
25) $2\frac{375}{1000}$
26) $\frac{1365}{1000}$
27) $\frac{16}{1000}$
28) $120\frac{25}{100}$
29) $18\frac{6}{100}$
30) $\frac{36}{10}$

31) $100\frac{4}{10}$
32) $99\frac{44}{100}$
33) $3\frac{1416}{10000}$
34) $12\frac{57}{100}$
35) $4\frac{189}{1000}$
36) $\frac{556}{10}$
37) $\frac{99}{100}$
38) $1\frac{492}{1000}$
39) $5\frac{968}{1000}$
40) $1123\frac{5}{100}$

41) 5 tenths

42) 25 hundredths

43) 9 tenths

44) 36 hundredths

45) 4 hundredths

46) 23 and 8 tenths

47) 4 and 16 hundredths

48) 6 thousandths

49) 10 and 136 thousandths

50) 24 and 24 thousandths

PIX

Decimal fractions are commonly used in classifying library books, as you can see from signs in this large public library.

Addition and Subtraction of Decimal Fractions

Decimal fractions are added and subtracted like whole numbers. In writing the numbers to be added or subtracted, be sure to line up the decimal points and to put tenths beneath tenths, hundredths beneath hundredths, and so on. Lining up decimal points is especially important when you add or subtract decimal fractions having different denominators, as when you add $5 and $.37 or subtract $10.23 from $97.

Adding Decimal Fractions

Example: Find the sum of .6, 1.2, .37, and 3.81.

Write the numbers in columns, lining up the decimal points. Draw a line beneath the addends. Put a decimal point below the line, lining it up with the others. Add as you do whole numbers. Your work will look like this:

$$\begin{array}{r} .6 \\ 1.2 \\ .37 \\ \underline{3.81} \\ 5.98 \end{array} \quad \text{Answer}$$

PRACTICE

Copy each group of decimal fractions, writing the numbers in columns and being careful to line up the decimal points. Then add and check your addition.

1) .4, .2, .3
2) .8, .7, .5
3) .09, .06, .23
4) .86, .08, .17
5) .6, .27, .92
6) .5, .33, .19
7) .3, .26, 1.4
8) .7, .37, 3.5
9) .08, .7, .156
10) .24, .08, .3
11) .15, .72, .3, .65
12) .5, .32, .7, .47
13) .06, .345, .52, .79
14) .875, .29, .08, .74
15) .6533, .264, .2475, .813
16) .7582, .0634, .397, .361
17) 8.93, 7.68, 3.54, .28
18) 3.86, 7.37, 3.49, .75
19) 7.15, 6.93, .82, 77.04
20) 14.65, 1.46, 146.5, 13.09
21) \$.09, \$.37, \$.86
22) \$.24, \$.07, \$.39
23) \$1.26, \$4.75, \$8.13
24) \$1.24, \$2.18, \$7.12
25) \$5.05, \$4.51, \$38.14
26) \$4.22, \$1.72, \$19.03
27) \$1.75, \$1.87, \$.59
28) \$3.32, \$.39, \$2.27
29) \$20, \$1.31, \$7.50
30) \$16, \$3.21, \$9.50
31) \$200, \$20, \$2, \$.20
32) \$500, \$50, \$5, \$.50
33) \$7.15, \$35, \$6.93, \$.82, \$77.04
34) \$47, \$5.83, \$.96, \$7.99, \$80.20
35) .86, .89, .892, .893, 8.91
36) 7.2, .726, 7.26, .73, .7
37) 6.397, 94.371, 8.366, 14.075
38) 7.688, 35.047, 6.005, 27.745
39) .12, .74, .18, .94, .8, .9, .6
40) .25, .93, .18, .76, .1, .4, .5

Subtracting Decimal Fractions

Example: Find the difference between 2.17 and 3.8.

(1) Write the smaller number beneath the larger. Line up the decimal points. Draw a line beneath the subtrahend. Put a decimal point below the line, lining it up with the others.

$$\begin{array}{r} 3.8 \\ \underline{-2.17} \\ . \end{array}$$

(2) Begin at the column farthest to the right. There is no figure in this column of the minuend; so put a 0 in this space. (That is, write 3.8 as the equivalent decimal fraction 3.80.) Now subtract just as with whole numbers.

$$\begin{array}{rl} 3.80 & \\ \underline{-\,2.17} & \\ 1.63 & \text{Answer} \end{array}$$

(3) Check your work by adding:

$$\begin{array}{rl} 1.63 & \\ \underline{+\,2.17} & \\ 3.80 & \text{Check} \end{array}$$

PRACTICE

Find the difference in each case, checking your work by addition.

1) .77, .28
2) .54, .35
3) 4.3, 3.9
4) 5.3, 4.6
5) 8.0, 3.8
6) 6.0, 1.6
7) 5.74, 2.57
8) 8.61, 5.39
9) 52.8, 37.8
10) 53.2, 27.2
11) 9.16, .18
12) 3.43, .46
13) .86, .81
14) .54, .52
15) .7471, .5578
16) .9532, .6637
17) 3.6, 1.25
18) 4.7, 2.45
19) 8, 3.8
20) 6., 1.6

21) 5.14, 2.573
22) 8.11, 5.394
23) 41.62, 53.6
24) 31.97, 52.3
25) 2, .2
26) 5, .5
27) 9, 17.9
28) 6, 13.5
29) .41, .9
30) .62, .8
31) $70.36, $167
32) $16.27, $66
33) $55, $90.06
34) $29, $47.04
35) $1, $.29
36) $1, $.87
37) $15, $13.97
38) $5, $2.76
39) $10, $8.94
40) $20, $18.75

Multiplication of Decimal Fractions

To multiply decimal fractions correctly, you must be able to determine the position of the decimal point in the product. You should also be able to estimate the product, as a precaution against making errors in placing the decimal point.

Instruments known as micrometer calipers are used for checking accuracy of work in a machine shop. To use them, a worker must understand the addition and multiplication of decimal fractions.

BLACK STAR

Placing the Decimal Point in a Product

Examples: (*A*)
$$\begin{array}{r} .16 \\ 4 \\ \hline .64 \end{array} \quad \text{Answer}$$

(*B*)
$$\begin{array}{r} .004 \\ .3 \\ \hline .0012 \end{array} \quad \text{Answer}$$

(*C*)
$$\begin{array}{r} 12 \\ .5 \\ \hline 6.0 \end{array} \quad \text{Answer}$$

Count the total number of decimal places in the multiplier and the multiplicand,

and then count off the same number of places in the product, beginning at the right.

PRACTICE

Copy the products in items 1–25, putting in the decimal points. Find the products in items 26–50.

1) 1.47 × 7 = 1029
2) 382 × .8 = 3056
3) 840 × .005 = 4200
4) .24 × 6 = 144
5) 5064 × .04 = 20256
6) .88 × .4 = 352
7) .006 × .07 = 42
8) .08 × .06 = 48
9) 1.62 × 4.3 = 6966
10) 1.56 × 7.2 = 11232
11) .006 × 5 = 30
12) .032 × 8 = 256
13) 14.5 × 12 = 1740
14) 875 × .016 = 14000
15) 7.071 × 9 = 63639
16) .074 × .6 = 444
17) .004 × .002 = 8
18) 12.4 × 3.5 = 4340
19) 65.1 × 2.7 = 17577
20) 3.08 × .45 = 13860
21) 3 × $4.80 = $1440
22) 12 × $238.50 = $286200
23) 9 × $412.33 = $371097
24) 8 × $50.35 = $40280
25) 52 × $40.83 = $212316

26) .6 × 5
27) 8 × .4
28) 1.25 × 8
29) 1.56 × 6
30) .072 × 8
31) .049 × 7
32) .2 × .3
33) .8 × .9
34) .04 × .7
35) .8 × .06
36) 2.45 × 4.31
37) 1.56 × 1.46
38) 6.437 × 1.29
39) 9.875 × 4.36
40) 52 × $49.50
41) 12 × $252.50
42) 6 × $3.15
43) 5 × $4.74
44) 24 × $4.35
45) 36 × $4.75
46) .8 × 9.48
47) .512 × .305
48) .41 × 51.2
49) .9 × .33
50) .2 × 3

Estimating Products

Example: Estimate a reasonable answer for this multiplication: 20.3146 × 6.75.

(1) Consider the multiplicand and the multiplier as the next lower whole numbers, and multiply.

$$20 \times 6 = 120$$

(2) Consider the multiplicand and the multiplier as the next higher whole numbers and multiply.

$$21 \times 7 = 147$$

(3) The answer must lie somewhere between 120 and 147. It will have three figures to the left of the decimal point.

PRACTICE

For each of the following items, four answers have been given. Only one of each group is correct. Using the method given above, estimate the products and select the answers you think are correct.

1)	1.98 × 20.5	=	4.059	40.59	405.9	.4059
2)	2.35 × 1.6	=	3.76	.376	37.6	376
3)	8.7 × 3.6	=	3.132	24.42	31.32	36.42
4)	10.05 × 8.62	=	86.631	80.631	8.6631	866.31
5)	6.97 × 50.2	=	34.9894	3498.94	350.194	349.894
6)	4.09 × 30.5	=	12.4745	124.745	120.45	1247.45
7)	60 × 3.84	=	23.04	23040	230.4	2.304
8)	.04 × 36	=	144	14.4	1.44	.144
9)	8.75 × 25.2	=	2.2050	22.050	220.50	2205
10)	96.4 × 8.7	=	8.3868	83.868	838.68	8386.8

Multiplying Powers of Ten

When a number is multiplied by itself, the product is called the *second power* of the number. When the second power of a number is multiplied by the number, the product is called the *third power* of the number.

$$10 \times 10 = 100;\ 100 \text{ is the second power of } 10$$
$$10 \times 10 \times 10 = 1000;\ 1000 \text{ is the third power of } 10$$
$$10 \times 10 \times 10 \times 10 = 10{,}000;\ 10{,}000 \text{ is the fourth power of } 10$$

To multiply 10 or a power of 10, move the decimal point to the right as many places as there are zeros in the multiplicand. If there are not enough decimal places to permit you to do so, as in Example C, write as many zeros as you need after the last figure in the decimal fraction.

Examples: (*A*) .21 × 10 = 2.1 Answer
(*B*) .21 × 100 = 21. Answer
(*C*) .21 × 1000 = 210. Answer

PRACTICE

Multiply, writing only the products.

1) 4.5 × 10
2) .5 × 10
3) .46 × 100
4) .4 × 100
5) 2.6 × 1000
6) .91 × 1000
7) 9.2 × 100
8) .36 × 10
9) 90 × 10
10) .8 × 100
11) .333 × 100
12) .6 × 1000
13) .248 × 10
14) 1.382 × 10
15) 1.47 × 1000
16) .002 × 100
17) .147 × 1000
18) .003 × 10
19) 26.7 × 10
20) .47 × 100
21) 3.1416 × 10
22) 1.732 × 100
23) 1.414 × 1000
24) 62.4 × 1000
25) 12.5 × 100
26) .667 × 10
27) .13 × 100
28) .024 × 100
29) .07 × 1000
30) .009 × 1000

Division of Decimal Fractions

In dividing decimal fractions, as in all work with decimals, you must place the decimal point correctly. To make sure that you do so, you should estimate your quotient.

Dividing a Decimal Fraction by a Whole Number

Example: Divide 13.2 by 8.

(1) Set up the problem. Place the decimal point in the quotient directly above the decimal point in the dividend.

```
    .
8)13.2
```

(2) Divide as usual. If there is a remainder, carry the quotient to one more decimal place than there is in the dividend. To do this, put a zero after the last figure.

```
   1.65  Answer
8)13.20
  8
  5 2
  4 8
    40
    40
     0
```

(3) Check by multiplying the quotient by the divisor.

PRACTICE

Find the quotients, checking them by multiplication:

1) $3\overline{).75}$
2) $3\overline{).51}$
3) $4\overline{)4.64}$
4) $27\overline{)57.51}$
5) $3\overline{).255}$
6) $24\overline{).624}$
7) $6\overline{)82.74}$
8) $5\overline{)79.05}$
9) $67\overline{).1742}$
10) $6\overline{).1938}$
11) $12\overline{)\$11.88}$
12) $16\overline{)\$15.52}$
13) $8\overline{)\$7.76}$
14) $9\overline{)\$8.55}$
15) $22\overline{)\$21.78}$

Dividing by a Decimal Fraction

Example: Find this quotient: $.04\overline{)2.6}$.

Multiply the divisor by the smallest power of 10 that will give a whole number as a product. In this case move the decimal point two places to the right. Multiply the dividend by the same power of 10. Then divide as usual. Arrange your work like this:

$$\begin{array}{r} 65.\ \text{Answer} \\ .04\overline{)2.60} \\ \underline{2\,4} \\ 20 \\ \underline{20} \\ 0 \end{array}$$

PRACTICE

The answers to items 1–10 are incorrect because they do not contain decimal points. Give the correct answers to these items. In items 11–50, do the divisions, carrying the quotients to one more decimal place than the number of decimal places in the dividend, if necessary.

1) $.72 \div .6 = 12$

2) $.496 \div .08 = 62$

3) $1.675 \div .5 = 335$

4) $83.79 \div .09 = 931$

5) $1.491 \div .007 = 213$

6) $1.026 \div .019 = 54$

7) $.9675 \div 21.5 = 45$

8) $.9984 \div 3.84 = 26$

9) $812.5 \div 6.5 = 125$

10) $60.8 \div .008 = 76$

11) $.03\overline{).456}$

12) $.05\overline{).855}$

13) $.6\overline{)1233.6}$

14) $.8\overline{)1051.2}$

15) $.005\overline{)9.45}$

16) $.007\overline{)9.73}$

17) $2.4\overline{).216}$

18) $3.9\overline{).2613}$

19) $.08\overline{)64}$

20) $.09\overline{)81}$

21) $1.5\overline{)18.99}$

22) $1.4\overline{)13.23}$

23) $1.28\overline{).96}$

24) $2.35\overline{).329}$

25) $.36\overline{).3328}$

26) $.34\overline{).2805}$

27) $.028\overline{).1834}$

28) $.048\overline{).3864}$

29) $8.2\overline{)3.157}$

30) $9.6\overline{)4.656}$

31) $85 \div .034$

32) $351 \div .027$

33) $.2001 \div .87$

34) $.207 \div .23$

35) $32.9 \div .35$

36) $17.6 \div .32$

37) $.4125 \div .75$

38) $.9021 \div .93$

39) $.836 \div 3.8$

40) $.819 \div 3.9$

41) $26.54 \div .51$

42) $50.4 \div 3.6$

43) $7185 \div 1.5$

44) $877 \div .047$

45) $3.026 \div 8.9$

46) $.671 \div 7.4$

47) $.3008 \div 4.7$

48) $88.2 \div .98$

49) $24 \div .015$

50) $423.5 \div 6.1$

Estimating Quotients

Example: Estimate a reasonable answer for this division: $81.286 \div 15.974$.

(1) Consider the dividend as the nearest whole number.

That is, consider 81.286 as 81.

(2) Consider the divisor as the nearest whole number.

That is, consider 15.974 as 16.

(3) Divide the whole numbers:

$$\begin{array}{r} 5 \\ 16\overline{)81} \end{array} \quad \text{Estimate}$$

PRACTICE

For each of the following items, four answers are suggested, of which only one is correct. Using the method given above, estimate the quotients and select the correct answers.

1)	26.1 ÷ 2.9	=	13	9	1.1	19.8
2)	31.2 ÷ 3.9	=	8	11	93.6	1.9
3)	24.96 ÷ 3.2	=	7	80	.8	7.8
4)	37.2 ÷ 9.3	=	40	3.7	4	.38
5)	26.1 ÷ .9	=	260	.3	18	29
6)	21.6 ÷ .8	=	1.5	.3	27	16
7)	11.91 ÷ 3.97	=	4	3	35	3.5
8)	11.764 ÷ 2.941	=	4	3	.6	5.5
9)	41.013 ÷ 5.859	=	6.2	62	.69	7
10)	59.51 ÷ 10.82	=	5.5	60	50	6

Dividing by Powers of Ten

Examples: (*A*) 75 ÷ 10 = 7.5 Answer
(*B*) 84.2 ÷ 100 = .842 Answer
(*C*) 53.6 ÷ 1000 = .0536 Answer

To divide a whole number or a decimal fraction by 10 or a power of 10, move the decimal point in the dividend to the left as many places as there are zeros in the divisor. If you need to do so, as in Example C, write zeros in front of the first digit in the dividend.

PRACTICE

Divide as indicated, writing only the quotients:

1) 25 ÷ 10
2) 12.5 ÷ 10
3) .375 ÷ 10
4) 3.75 ÷ 10
5) 5 ÷ 10
6) 62.5 ÷ 100
7) 7.9 ÷ 100
8) .35 ÷ 100
9) 8 ÷ 100
10) 500 ÷ 1000

11) 507.5 ÷ 1000

12) 5280 ÷ 1000

13) 1931 ÷ 1000

14) 58 ÷ 1000

15) 14 ÷ 10

16) .25 ÷ 10

17) 8.5 ÷ 10

18) .003 ÷ 10

19) .62 ÷ 10

20) 1 ÷ 100

21) 119.50 ÷ 1000

22) 119.50 ÷ 100

23) 119.50 ÷ 10

24) $.863 ÷ 10

25) $1.87 ÷ 100

26) $43.50 ÷ 100

27) $2.00 ÷ 100

28) $.10 ÷ 10

29) $.025 ÷ 10

30) $74.20 ÷ 100

Rounding Off Decimal Fractions

Decimal fractions, like whole numbers, may be rounded off. You can express numbers to the nearest tenth, to the nearest hundredth, to the nearest thousandth, and so on.

Probably decimal fractions are rounded off most frequently in figuring costs, for costs are usually expressed to the nearest cent (that is, to the nearest hundredth of a dollar) or to the nearest tenth of a cent. But there are other occasions on which you should round off decimal fractions. Here is an illustration:

Suppose you want to know the circumference of a tube, but do not have a tape with which to measure it. So you measure the diameter and calculate the circumference. Let us say that the diameter is 10.1 inches. Your measurement is accurate to the nearest tenth of an inch. Therefore, when you calculate the circumference, you must round off your answer to the nearest tenth of an inch. A computed value can be no more accurate than the measurement on which it is based.

As you know, you find the circumference of a circle by multiplying the diameter by π. One value of π is 3.14; a more

exact value is 3.1416; a still more exact value is 3.14159. The value of π to use when a measurement contains one or two decimal places is 3.14. These figures show why:

$$10.1 \times 3.14 = 31.714 = 31.7$$
$$10.1 \times 3.1416 = 31.73016 = 31.7$$
$$10.1 \times 3.14159 = 31.730059 = 31.7$$

How to Round Off Decimal Fractions to a Given Accuracy

Example A: Express .6853 to the nearest thousandth.

Think: Which is closer to .6853 — .6850 or .6860?
The answer is .685.

Example B: Express .303 to the nearest hundredth.

Think: Which is closer to .303 — .300 or .310?
The answer is .30.

Example C: Express .497 to the nearest tenth.

Think: Which is closer to .497 — .400 or .500?
The answer is .5.

PRACTICE

Give each of the following to the accuracy indicated.

1. The value of π — 3.14159 —

a. to the nearest ten-thousandth

b. to the nearest thousandth

c. to the nearest hundredth

d. to the nearest tenth

2. These sums, to the nearest hundredth:

a. .234 + 1.867

b. 30.495 + 7.303

c. .9208 + .861

d. 2.546 + 11.709 + 4.948

e. 123.675 + 99.365 + 108.009

f. \$12.367 + \$15.972 + \$31.453

3. These differences, to the nearest thousandth:

a. .5346 − .0002 **c.** .8177 − .4969

b. .301 − .1407 **d.** 6.7982 − 3.4451

4. These products, to the nearest tenth:

a. .8 × .7 **c.** 5.1 × .3

b. .21 × .11 **d.** .56 × 1.7

5. These quotients, to the nearest hundredth:

a. 5.76 ÷ .38 **c.** .11 ÷ 18

b. .79 ÷ 2.61 **d.** 17.25 ÷ 29.6

Expressing Common Fractions as Decimal Fractions

To change a common fraction to a decimal fraction, divide the numerator of the common fraction by its denominator. You can do so because a common fraction really expresses a division. That is, 30 ÷ 5 is the same as $\frac{30}{5}$, and 3 ÷ 4 is the same as $\frac{3}{4}$.

Changing Common Fractions to Decimals

Example: Change $\frac{7}{8}$ to a decimal fraction with three decimal places.

Write the common fraction as a problem in division, adding zeros as necessary. (Remember that a whole number can be written with a decimal point after the ones place.) Divide as usual.

$$
\begin{array}{r l}
.875 & \text{Answer} \\
8\overline{)7.000} & \\
\underline{6\,4} & \\
60 & \\
\underline{56} & \\
40 & \\
\underline{40} & \\
0 &
\end{array}
$$

PRACTICE

Change the following common fractions to decimals, expressing each to the nearest thousandth.

1) $\frac{1}{2}$	6) $\frac{2}{5}$	11) $\frac{1}{3}$	16) $\frac{5}{2}$
2) $\frac{3}{4}$	7) $\frac{7}{10}$	12) $\frac{5}{6}$	17) $\frac{11}{10}$
3) $\frac{5}{8}$	8) $\frac{10}{20}$	13) $\frac{4}{3}$	18) $\frac{23}{20}$
4) $\frac{9}{16}$	9) $\frac{19}{25}$	14) $\frac{15}{16}$	19) $\frac{24}{25}$
5) $\frac{7}{4}$	10) $\frac{11}{16}$	15) $\frac{19}{20}$	20) $\frac{17}{12}$

Comparing the Size of Fractions

Example: How much larger is $\frac{7}{8}$ than $\frac{4}{5}$?

(1) Change each of the fractions to decimal fractions.

$$7 \div 8 = .875$$
$$4 \div 5 = .800$$

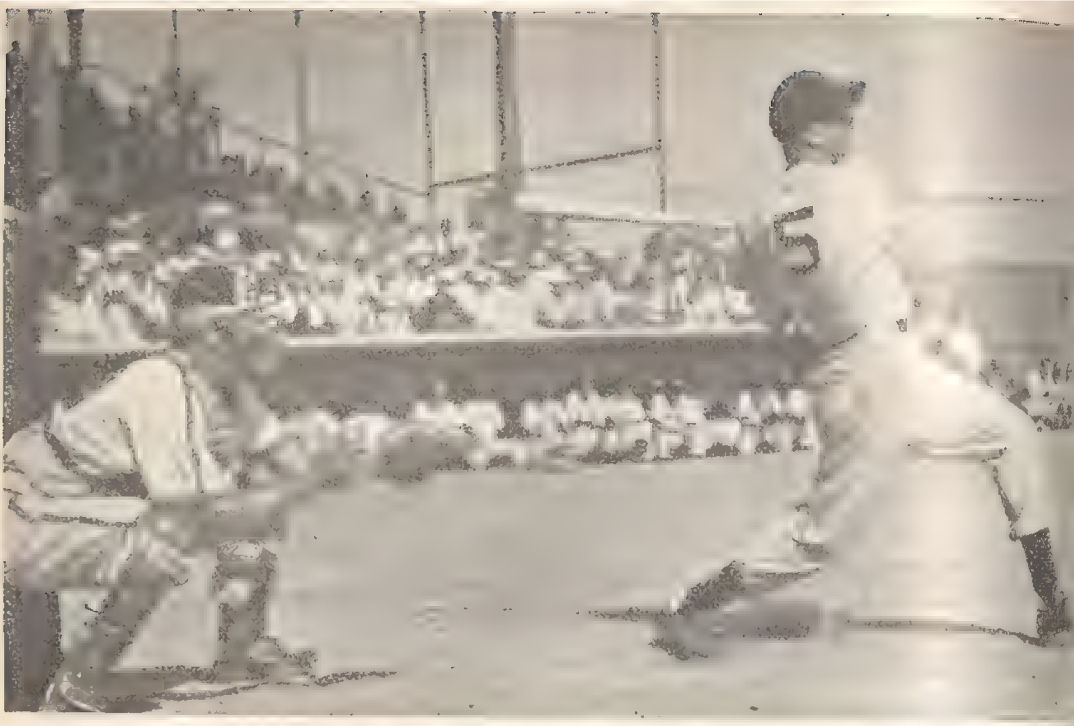
(2) Subtract the smaller decimal fraction from the larger.

$$.875 - .800 = .075 \quad \text{Answer}$$

PRACTICE

In each case, tell which fraction is larger, and by how much it exceeds the other.

1) $\frac{1}{2}, \frac{3}{5}$	6) $\frac{5}{8}$, .600	11) $\frac{5}{7}, \frac{3}{5}$
2) $\frac{1}{6}, \frac{1}{8}$	7) $\frac{4}{25}$, .180	12) $\frac{2}{3}, \frac{7}{10}$
3) $\frac{9}{10}, \frac{19}{20}$	8) .600, $\frac{2}{3}$	13) $\frac{1}{6}$, .161
4) $\frac{9}{16}, \frac{1}{2}$	9) .130, $\frac{7}{50}$	14) $\frac{3}{16}$, .225
5) $\frac{5}{6}, \frac{4}{5}$	10) .090, $\frac{1}{9}$	15) $\frac{1}{32}$, .025



INTERN

Batting averages are per cents. When you read that Joe DiMaggio's batting average one year was .320, you know that he made hits 32.0 per cent of the number of times he was at bat.

UNDERSTANDING PER CENTS

A per cent is a fraction with a denominator of 100, but only the numerator is written. The denominator is represented by the sign % or by the term *per cent* which means hundredths. Fifty per cent — that is, 50% — means 50 hundredths, $\frac{50}{100}$, or .50. Here are some other illustrations:

Per Cent	*Common Fraction*	*Decimal Fraction*
25%	$\frac{25}{100} = \frac{1}{4}$	.25
5%	$\frac{5}{100} = \frac{1}{20}$	.05
2.5%	$\frac{2.5}{100} = \frac{25}{1000} = \frac{1}{40}$	.025
$12\frac{1}{2}$%	$\frac{12.5}{100} = \frac{125}{1000} = \frac{1}{8}$	.125
100%	$\frac{100}{100} = 1$	1.00
125%	$\frac{125}{100} = 1\frac{25}{100} = 1\frac{1}{4}$	1.25

To change a per cent to a common fraction or a mixed number, replace the per cent sign by the denominator it represents — that is, by 100 — and reduce to lowest terms.

To change a per cent to a decimal fraction, drop the per cent sign and multiply the number by .01 — that is, move the decimal point two places to the left. To change a decimal fraction to a per cent, multiply by 100 and write a per cent sign after the number. To change a common fraction to a per cent, change it first to a decimal fraction (see page 98).

PRACTICE

1. Express each of the following per cents as a common fraction reduced to its lowest terms:

a. 10% **d.** 40% **g.** 70% **j.** 90%

b. 20% **e.** 50% **h.** 75% **k.** $2\frac{1}{2}\%$

c. 30% **f.** 60% **i.** 80% **l.** 12.5%

2. Express each of the following as a mixed number or a whole number:

a. 100% **b.** 125% **c.** 150% **d.** 175%

3. Change each per cent to a decimal fraction:

a. 35% **d.** 30% **g.** 36% **j.** 7.5%

b. 22% **e.** 60% **h.** 62.5% **k.** 125%

c. 5% **f.** 28% **i.** 4.7% **l.** 95%

4. Give each of the following decimal fractions as a per cent:

a. .61 **d.** .17 **g.** .46 **j.** .375

b. .06 **e.** .81 **h.** .463 **k.** .621

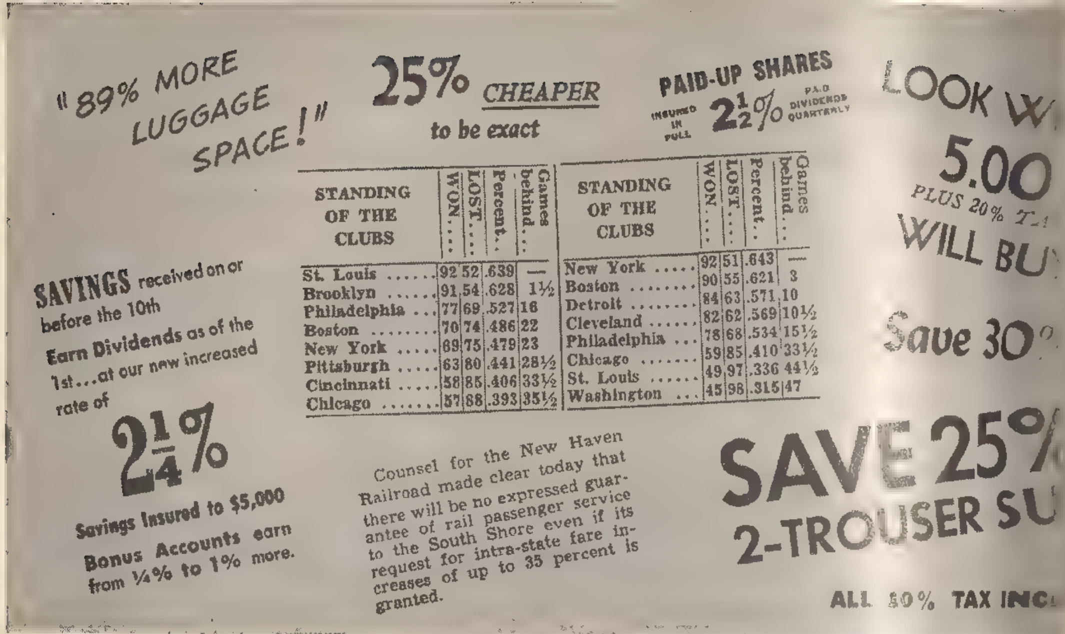
c. .10 **f.** .4 **i.** .125 **l.** 1.25

5. Give each of the following fractions either as a whole per cent or to the nearest tenth per cent:

a. $\frac{1}{4}$ **d.** $\frac{7}{10}$ **g.** $\frac{9}{5}$ **j.** $\frac{13}{10}$ **m.** $\frac{10}{9}$

b. $\frac{1}{2}$ **e.** $\frac{3}{8}$ **h.** $\frac{11}{4}$ **k.** $\frac{7}{3}$ **n.** $\frac{3}{16}$

c. $\frac{2}{5}$ **f.** $\frac{6}{5}$ **i.** $\frac{5}{2}$ **l.** $\frac{11}{6}$ **o.** $\frac{9}{16}$



"89% MORE LUGGAGE SPACE!"

25% CHEAPER to be exact

PAID-UP SHARES INSURED IN FULL $2\frac{1}{2}$% PAID DIVIDENDS QUARTERLY

LOOK W

5.00 PLUS 20% T

WILL BU

STANDING OF THE CLUBS	WON	LOST	Percent	Games behind
St. Louis	92	52	.639	—
Brooklyn	91	54	.628	1½
Philadelphia	77	69	.527	16
Boston	70	74	.486	22
New York	69	75	.479	23
Pittsburgh	63	80	.441	28½
Cincinnati	58	85	.406	33½
Chicago	57	88	.393	35½

STANDING OF THE CLUBS	WON	LOST	Percent	Games behind
New York	92	51	.643	—
Boston	90	55	.621	3
Detroit	84	63	.571	10
Cleveland	82	62	.569	10½
Philadelphia	78	68	.534	15½
Chicago	59	85	.410	33½
St. Louis	49	97	.336	44½
Washington	45	98	.315	47

SAVINGS received on or before the 10th Earn Dividends as of the 1st...at our new increased rate of

$2\frac{1}{4}$%

Savings Insured to $5,000

Bonus Accounts earn from ¼% to 1% more.

Save 30

Counsel for the New Haven Railroad made clear today that there will be no expressed guarantee of rail passenger service to the South Shore even if its request for intra-state fare increases of up to 35 percent is granted.

SAVE 25%

2-TROUSER SU

ALL 20% TAX INC

These references to per cents were clipped from a single issue of a newspaper. There were other references in the same issue, also.

Multiplying and Dividing by Per Cents

To multiply or divide by a per cent, change the per cent to a decimal or common fraction, and proceed as usual.

Finding a Given Per Cent of a Number

Multiply by a per cent whenever you want to find a given per cent of a number; for example, to find 85% of 532.

Example: Find 75% of 240.

Express the per cent as a common fraction and multiply the whole number by the fraction:

$$75\% = \frac{75}{100} = \frac{3}{4}$$

$$\frac{3}{4} \times 240 = 180 \quad \text{Answer}$$

Another method is to express the per cent as a decimal fraction, and multiply the number by the decimal:

$$75\% = .75$$

$$.75 \times 240 = 180.00 \quad \text{Answer}$$

PRACTICE

Use either procedure to find the following values. Give the answers either as whole numbers or to the nearest tenth.

1) 25% of 16
2) $33\frac{1}{3}$% of 24
3) 10% of 120
4) $12\frac{1}{2}$% of 32
5) $16\frac{2}{3}$% of 36
6) $87\frac{1}{2}$% of 480
7) 75% of 120
8) 50% of 96
9) $37\frac{1}{2}$% of 40
10) $66\frac{2}{3}$% of 27
11) .1% of 1200
12) .2% of 30
13) .03% of 640
14) .5% of 50
15) 2.5% of 29.4
16) 4.2% of 76.3
17) 7.1% of 50.41
18) 13.5% of 182.25
19) 32.6% of 18.055
20) 21.9% of 14.799
21) 125% of 40
22) 200% of 25
23) 150% of 200
24) 105% of 800
25) 100% of 729
26) $\frac{1}{2}$% of 150
27) $\frac{1}{4}$% of 1675
28) $\frac{3}{4}$% of 120
29) $\frac{1}{3}$% of 210
30) $\frac{2}{3}$% of 860

Finding a Number from a Per Cent of It

Divide by a per cent whenever you want to find a number from a per cent of it; for example, to find a number when you know that 25% of it is 73.

Example: Sixty per cent of a number is 12. Find the number.

(1) Change the per cent to a decimal fraction.

Think: $.60 \times ? = 12$

(2) Use this decimal fraction as a divisor. Use the number given as dividend. Find the quotient.

$$\begin{array}{r} 20.\ \text{Answer} \\ .60\overline{)12.00} \end{array}$$

(3) Check by multiplying:

$$.60 \times 20 = 12 \quad \text{Check}$$

PRACTICE

1) 25% of what number is 10?
2) 50% of what number is 18?
3) 75% of what number is 24?
4) 60% of what number is 42?
5) 12% of what number is 30?
6) 21 is 70% of what number?
7) 15 is 30% of what number?
8) 32 is $33\frac{1}{3}$% of what number?
9) 15 is $7\frac{1}{2}$% of what number?
10) 3 is $1\frac{1}{2}$% of what number?
11) 6 is 3% of what number?
12) 31.25 is 25% of what number?
13) 20.16 is $37\frac{1}{2}$% of what number?
14) 22.4 is $33\frac{1}{3}$% of what number?
15) 70.4 is $66\frac{2}{3}$% of what number?
16) Of what number is 5% equal to 85?
17) Of what number is 4% equal to 132?
18) 125% of what number is 750?
19) 350% of what number is 350?
20) $116\frac{2}{3}$% of what number is 875?

Using Per Cents to Compare Numbers

A common way to compare two numbers is to find what per cent one number is of the other. Or you may find the per cent by which one number exceeds another, or the per cent by which one number is less than another.

Finding What Per Cent One Number Is of Another

Example: Find what per cent 22 is of 25.

(1) Write a common fraction comparing the two quantities. Ask: 22 is what part of 25? Reply: It is $\frac{22}{25}$.

(2) Change the common fraction to a per cent.

$$\frac{22}{25} = \frac{88}{100} = .88 = 88\% \quad \text{Answer}$$

PRACTICE

Find what per cent the first number is of the second. Give either an exact per cent or a per cent to the nearest tenth of a per cent.

1) 12, 36	**11)** 5.1, 30.6	**21)** $1.20, $6
2) 15, 25	**12)** 8.2, 73.8	**22)** $3.60, $9
3) 3, 8	**13)** .6, 2.4	**23)** 18, 42
4) 15, 500	**14)** .9, 9.9	**24)** 22, 32
5) 25, 200	**15)** .25, 6.25	**25)** 10, 15
6) 2.5, 10	**16)** $16, $40	**26)** 10.5, 18
7) 3.2, 64	**17)** $76.50, $1275	**27)** 14.2, 75
8) 4.2, 252	**18)** $7.50, $37.50	**28)** 16.2, 264
9) 7, 18.9	**19)** $6.25, $18.75	**29)** 21, 32.9
10) 13, 49.4	**20)** $.45, $2.25	**30)** 28, 64.4

Finding the Per Cent by Which One Number Exceeds Another

Example: By what per cent does 250 exceed 200?

(1) Find the difference between the two numbers:

$$250 - 200 = 50$$

(2) Write a common fraction comparing the difference with the smaller number, and change the common fraction to a per cent:

$$\frac{50}{200} = .25 = 25\% \quad \text{Answer}$$

PRACTICE

Find the per cent by which the larger number is greater than the smaller. Give each answer either as a whole per cent or to the nearest tenth per cent.

1) 150, 200
2) 18, 20
3) 750, 1000
4) 900, 936
5) 250, 260
6) 1.5, 5
7) 2.5, 20
8) 1.2, 36
9) 9, 27.9
10) 3, 11.1
11) 17.5, 19.25
12) 6.25, 18.75
13) 7.5, 37.5
14) 1.25, 2.5
15) .4, 6.4
16) \$75, \$100
17) \$37.50, \$50
18) \$18.75, \$25
19) \$18.40, \$21.16
20) \$75.60, \$84.67

The Per Cent by Which One Number Is Smaller than Another

Example: By what per cent is 48 less than 50?

(1) Find the difference between the two numbers:

$$50 - 48 = 2$$

(2) Write a common fraction comparing the difference with the larger number. Change the common fraction to a per cent:

$$\frac{2}{50} = \frac{4}{100} = 4\% \quad \text{Answer}$$

PRACTICE

Find the per cent by which the smaller number is less than the larger, either as a whole per cent or to the nearest tenth per cent.

1) 20, 15
2) 25, 20
3) 100, 75
4) 225, 200
5) 120, 96
6) 4.5, 5
7) 7.5, 10
8) 2, 12.5
9) 14, 16.8
10) 18, 22.4
11) 5.25, 7.25
12) 8.8, 12.8
13) 4.9, 5.3
14) 12.3, 15.7
15) .32, .54
16) \$17.50, \$15.75
17) \$.46, \$.32
18) \$.64, \$.56
19) \$1.75, \$1.45
20) \$2.95, \$2.59

Review Tests on Computation

The tests that follow match those at the beginning of this chapter. Your scores will tell you what improvement you have made and what processes you still must practice.

TEST ON WHOLE NUMBERS

Add:

1) 8, 7, 3

2) 9, 6, 7, 5

3) 45, 8, 27, 36, 8

4) 19, 45, 4, 36, 8

5) 78, 84, 57, 63

6) 650, 85, 274, 37

7) 356, 80, 179, 716, 98

8) 5683, 1858, 796, 950

9) 3468, 940, 2689, 798, 236

10) 76,043, 3,649, 12,360, 2,504, 62,736

Subtract:

11) 86 − 32

12) 72 − 35

13) 741 − 437

14) 825 − 389

15) 500 − 63

16) 3960 − 2884

17) 2403 − 304

18) 7834 − 4079

19) 48,000 − 26,575

20) 69,036 − 35,987

Multiply:

21) $\begin{array}{r} 702 \\ \underline{\quad 3} \end{array}$ **22)** $\begin{array}{r} 653 \\ \underline{\quad 2} \end{array}$ **23)** $\begin{array}{r} 324 \\ \underline{\quad 4} \end{array}$ **24)** $\begin{array}{r} 513 \\ \underline{\quad 7} \end{array}$ **25)** $\begin{array}{r} 3{,}418 \\ \underline{\quad 6} \end{array}$

26) $\begin{array}{r} 254 \\ \underline{\quad 65} \end{array}$ **27)** $\begin{array}{r} 405 \\ \underline{\quad 57} \end{array}$ **28)** $\begin{array}{r} 361 \\ \underline{800} \end{array}$

29) $\begin{array}{r} 1{,}506 \\ \underline{\quad 23} \end{array}$ **30)** $\begin{array}{r} 657 \\ \underline{409} \end{array}$

Divide:

31) $4\overline{)484}$

32) $3\overline{)243}$

33) $7\overline{)420}$

34) $9\overline{)6{,}390}$

35) $5\overline{)3{,}632}$

36) $24\overline{)528}$

37) $29\overline{)58{,}000}$

38) $67\overline{)6{,}770}$

39) $18\overline{)11{,}034}$

40) $75\overline{)8{,}232}$

How do you rate?	Excellent	Good	Fair	Poor
	40	38–39	35–37	34 or less

TEST ON COMMON FRACTIONS

Add:

1) $\begin{array}{r}\frac{5}{8}\\ \underline{\frac{3}{8}}\end{array}$

2) $\begin{array}{r}7\frac{1}{2}\\ \underline{4\frac{4}{5}}\end{array}$

3) $\begin{array}{r}5\frac{1}{3}\\ \underline{2\frac{1}{4}}\end{array}$

4) $\begin{array}{r}4\frac{1}{4}\\ \underline{3\frac{3}{8}}\end{array}$

5) $\begin{array}{r}\frac{1}{4}\\ \underline{\frac{9}{16}}\end{array}$

6) $\begin{array}{r}3\frac{1}{2}\\ 2\frac{5}{8}\\ \underline{4\frac{1}{4}}\end{array}$

7) $\frac{3}{8}+\frac{1}{4}$

8) $\frac{2}{5}+\frac{1}{5}$

9) $\frac{5}{6}+\frac{5}{6}$

10) $\frac{2}{5}+\frac{9}{10}+\frac{1}{2}$

Subtract:

11) $\begin{array}{r}\frac{7}{8}\\ \underline{\frac{3}{8}}\end{array}$

12) $\begin{array}{r}6\frac{9}{10}\\ \underline{3\frac{1}{10}}\end{array}$

13) $\begin{array}{r}10\frac{3}{4}\\ \underline{5\frac{1}{3}}\end{array}$

14) $\begin{array}{r}8\frac{3}{5}\\ \underline{4\frac{1}{2}}\end{array}$

15) $\begin{array}{r}7\frac{3}{4}\\ \underline{2\frac{7}{12}}\end{array}$

16) $\begin{array}{r}17\frac{3}{8}\\ \underline{10\frac{1}{2}}\end{array}$

17) $\frac{4}{5}-\frac{2}{5}$

18) $7\frac{5}{8}-2\frac{3}{8}$

19) $9\frac{1}{5}-3\frac{3}{5}$

20) $5-2\frac{2}{3}$

Multiply:

21) $\frac{1}{4} \times 20$

22) $\frac{3}{8} \times 16$

23) $\frac{1}{4} \times \frac{1}{3}$

24) $\frac{4}{5} \times 6\frac{2}{3}$

25) $\frac{3}{10} \times \frac{15}{16}$

26) $5 \times 2\frac{1}{2}$

27) $3\frac{1}{4} \times 1\frac{3}{5}$

28) $2\frac{1}{4} \times 5\frac{1}{3} \times 1\frac{1}{2}$

29) $\begin{array}{r} 160 \\ \underline{4\frac{3}{4}} \end{array}$

30) $\begin{array}{r} 31\frac{1}{4} \\ \underline{5\phantom{\frac{1}{4}}} \end{array}$

Divide:

31) $\frac{5}{6} \div \frac{5}{6}$

32) $\frac{15}{16} \div \frac{3}{16}$

33) $2\frac{1}{4} \div \frac{1}{4}$

34) $2\frac{2}{3} \div 1\frac{3}{5}$

35) $10 \div \frac{2}{5}$

36) $5 \div \frac{1}{2}$

37) $8\frac{1}{2} \div 4\frac{1}{4}$

38) $\frac{2}{3} \div 6$

39) $4\frac{3}{4} \div 2$

40) $7 \div 3\frac{3}{4}$

How do you rate?	Excellent	Good	Fair	Poor
	39–40	36–38	30–35	29 or less

TEST ON DECIMAL FRACTIONS

Add:

1) .9 + .8 + .6
2) .67 + .83 + .30
3) 3.38 + 6.43 + 7.50
4) .47 + .06 + 4.72 + .58
5) 2.875 + 8.650 + .537
6) $.29 + $.13 + $.54 + $.38
7) $4.75 + $5.30 + $17.95

Subtract:

8) 6.5 − 3.8
9) .52 − .47
10) 92.4 − 56
11) 5.57 − 3.28
12) 3.662 − 2.605
13) $9.02 − $.64
14) $32 − $4.69

Multiply:

15) $\begin{array}{r} 5.6 \\ \underline{2.5} \end{array}$

16) $\begin{array}{r} 4.07 \\ \underline{.72} \end{array}$

17) $\begin{array}{r} 61.9 \\ \underline{1.04} \end{array}$

18) 64 × $.35

19) 240 × $.625

Divide:

20) 4)$.72
21) 34)$7.82
22) .96)480
23) 130 ÷ 16
24) 14.96 ÷ 2.4

Place the decimal point in each answer:

25) 320 × .015 = 4800
26) 1.6 × .6 = 96
27) 1000 × 8.1 = 81000
28) 520.6 ÷ 100 = 5206
29) 877.91 ÷ 25.3 = 347
30) .076 ÷ .4 = 19

How do you rate?	Excellent	Good	Fair	Poor
	29 or 30	27 or 28	25 or 26	24 or less

Multiply:

21) $\frac{1}{4} \times 20$

22) $\frac{3}{8} \times 16$

23) $\frac{1}{4} \times \frac{1}{3}$

24) $\frac{4}{5} \times 6\frac{2}{3}$

25) $\frac{3}{10} \times \frac{15}{16}$

26) $5 \times 2\frac{1}{2}$

27) $3\frac{1}{4} \times 1\frac{3}{5}$

28) $2\frac{1}{4} \times 5\frac{1}{3} \times 1\frac{1}{2}$

29) $\begin{array}{r} 160 \\ \underline{4\frac{3}{4}} \end{array}$

30) $\begin{array}{r} 31\frac{1}{4} \\ \underline{5\phantom{\frac{1}{4}}} \end{array}$

Divide:

31) $\frac{5}{6} \div \frac{5}{6}$

32) $\frac{15}{16} \div \frac{3}{16}$

33) $2\frac{1}{4} \div \frac{1}{4}$

34) $2\frac{2}{3} \div 1\frac{3}{5}$

35) $10 \div \frac{2}{5}$

36) $5 \div \frac{1}{2}$

37) $8\frac{1}{2} \div 4\frac{1}{4}$

38) $\frac{2}{3} \div 6$

39) $4\frac{3}{4} \div 2$

40) $7 \div 3\frac{3}{4}$

How do you rate?	Excellent	Good	Fair	Poor
	39–40	36–38	30–35	29 or less

TEST ON DECIMAL FRACTIONS

Add:

1) .9 + .8 + .6
2) .67 + .83 + .30
3) 3.38 + 6.43 + 7.50
4) .47 + .06 + 4.72 + .58
5) 2.875 + 8.650 + .537
6) $.29 + $.13 + $.54 + $.38
7) $4.75 + $5.30 + $17.95

Subtract:

8) 6.5 − 3.8
9) .52 − .47
10) 92.4 − 56
11) 5.57 − 3.28
12) 3.662 − 2.605
13) $9.02 − $.64
14) $32 − $4.69

Multiply:

15) $\begin{array}{r} 5.6 \\ \underline{2.5} \end{array}$

16) $\begin{array}{r} 4.07 \\ \underline{.72} \end{array}$

17) $\begin{array}{r} 61.9 \\ \underline{1.04} \end{array}$

18) 64 × $.35

19) 240 × $.625

Divide:

20) $4\overline{)\$.72}$
21) $34\overline{)\$7.82}$
22) $.96\overline{)480}$
23) 130 ÷ 16
24) 14.96 ÷ 2.4

Place the decimal point in each answer:

25) 320 × .015 = 4800
26) 1.6 × .6 = 96
27) 1000 × 8.1 = 81000
28) 520.6 ÷ 100 = 5206
29) 877.91 ÷ 25.3 = 347
30) .076 ÷ .4 = 19

How do you rate?	Excellent	Good	Fair	Poor
	29 or 30	27 or 28	25 or 26	24 or less

TEST ON PER CENT

1. Write .24 as a per cent.
2. Express 6% as a decimal.
3. Express 75% as a common fraction in simplest form.
4. Express $\frac{2}{5}$ as a per cent.
5. Write 0.034 as a per cent.
6. Write 3.6% as a decimal fraction.
7. Change $37\frac{1}{2}\%$ to a common fraction in lowest terms.
8. Express $\frac{3}{8}$ as a per cent.
9. What is 8 per cent of 625?
10. What per cent of 48 is 24?
11. Sixteen is 20 per cent of what number?
12. Find 3 per cent of 160.
13. What per cent of $5.00 is $4.50?
14. Forty-five is 25 per cent of what number?
15. What is $33\frac{1}{3}$ per cent of 120?
16. What per cent of 80 is 56?
17. Eight dollars is 10 per cent of what amount?
18. What is 1.5 per cent of 460?
19. What per cent of $90,000 is $3600?
20. Twenty-five is $66\frac{2}{3}$ per cent of what number?

How do you rate?	Excellent	Good	Fair	Poor
	20	18–19	15–17	14 or less

UNIT TWO

Earning and Managing Money

CHAPTER

3

GALLOWAY

1. Survey a group of high-school students (your mathematics class, your home room, the sophomores, the seniors) to find out how many earn money and the kinds of jobs they do.
2. Make a list of the opportunities in your community for high-school students to earn money.
3. Find out what laws govern the employment of boys and girls of high-school age.
4. Investigate the Federal and State laws that deal with wages and hours.
5. Find out the prevailing rates of pay for some of the jobs in your community.
6. Read newspapers and magazines for items about jobs and wages.

EARNING MONEY

EARNING MONEY IS IMPORTANT TO almost everyone. Perhaps you are already earning your own money after school, on Saturdays, and in vacations. If not, you probably expect to earn money later on. You will find it valuable to know the various methods by which people earn money, both while in school and after graduation. You will also find it helpful to know the different bases on which they are paid, and the average income of workers in various occupations.

Regular Jobs for Students

Some high-school students were asked to tell how they earned money. Many of them said that they had regular jobs after school and on Saturdays; others reported vacation jobs. These jobs included clerking in stores, working in factories, helping on farms, waiting on tables, and many other types of work.

Earnings of High-School Students

A student who has a regular job after school or on Saturdays is usually paid by the hour. Sometimes, especially during vacations, a student worker is paid by the day or the week. Rates of pay change from year to year, and are different in different parts of the country.

To find how much a person earns in a given length of time, you must know two things: (1) the rate at which he is paid; (2) the amount of time he works.

Example

Bill Garver works in a grocery store 3 hours each of the 5 school days of the week. He earns $.75 per hour.

a. How much does Bill earn each week?

b. If he works 38 weeks in a year, how much does he earn in all?

What to Do	How to Do It
(1) Find the number of hours worked each week	3 × 5 = 15
(2) Find the amount earned each week	15 × $.75 = $11.25 Answer (a) .75 × 15 = 11.25 Check
(3) Find the amount earned in a year	38 × $11.25 = $427.50 Answer (b) 11.25 × 38 = 427.50 Check

PROBLEMS

As you read each of these problems, ask yourself what facts are given you with which to work. Then solve the problem and check your answer.

1. Don Graves washes cars, changes oil, and does similar jobs in a garage after school. He works 3 hours per day and 5 days each week and receives $.75 per hour.

a. What does Don earn each week?

b. What does he earn during a school year of 38 weeks?

2. Fred Williams works in an office $2\frac{1}{2}$ hours each day 6 days each week doing clerical work. He is paid $.80 per hour.

a. How much does he earn each week?

b. How much does he earn in 34 weeks?

3. Five afternoons each week James Kramer works for two hours as a helper for a clerk in the storage room of a fur company. He also works 7 hours on Saturday. He is paid $.85 per hour.

a. What does he earn each week?
b. What are his total earnings for a school year of 38 weeks?

4. Rose Coleman earns money doing office work. She works 2 hours on each of the 5 school days and 6 hours on Saturday. She receives $.75 per hour.

a. What does she earn in a week?
b. What does she earn in 36 weeks?

5. During her summer vacation Sylvia Smith worked as a waitress 6 hours per day for 5 days each week. She was paid $.75 per hour and averaged $7.50 per week in tips. What were her total earnings for the twelve weeks?

6. Donald Moore works on a farm during the summer. One summer he worked as follows:

Plowed corn 15 days at $2.75 per day.
Shocked oats 5 days at $3.25 per day.
Helped with the hay 6 days at $3.50 per day.
Helped with the threshing 20 days at $3.00 per day.

Find his total earnings for the summer.

7. One year Ann Barkan earned money as a sales girl as follows: She worked after school 3 hours each day, 5 days per week for 36 weeks and in addition 8 hours each Saturday. At Christmas time she worked 8 hours per day for 6 days. During the summer she worked 4 hours per day, 6 days per week for 12 weeks. She was paid $.80 per hour.

a. How much did she earn after school?
b. How much did she earn on Saturdays during the school year?
c. How much did she earn during Christmas vacation?
d. How much did she earn during the summer?
e. What were her total earnings for the year?

A regular part-time job gives this boy an opportunity to apply the skills he learns in his classes.

BLACK STAR

8. Carl Owens received $.85 per hour as a clerk in a hardware store. During the 36 weeks of the school year he worked $2\frac{1}{2}$ hours each school day and 8 hours on Saturday; in the summer he worked 11 weeks, 7 hours per day, 5 days per week; and at Christmas time he worked 8 hours per day for 5 days.

a. How much did he earn after school?
b. How much did he earn on Saturdays?
c. How much did he earn during the summer time?
d. How much did he earn at Christmas time?
e. What were his total earnings for the year?

9. Robert Scarff has a job as a shipping clerk at $.80 per hour. In the past year he worked as follows: After school, 36 weeks, 5 days per week, 3 hours per day; Saturdays, 36 weeks, 4 hours per day; summer, 12 weeks, 7 hours per day, 6 days per week; and Christmas vacation, 10 days, $4\frac{1}{2}$ hours per day. What were his total earnings for the year?

10. Fred Pokorney worked as an assistant in the city natural history museum for $.90 per hour. He worked 30 Saturdays during the school year, one week at Christmas time, one week during the spring vacation, and 8 weeks during the summer. Each working day was 7 hours long, and there were 5 working days per week. How much did he earn during the year?

Student waitresses not only earn substantial amounts of money during the summer, but they also gain valuable experience in learning to please many different people.

Hourly Pay of Student Workers

In some jobs you may be paid by the day or week. To compare such a job with one in which you are paid by the hour, you must know the hourly rate of pay. You can find it by dividing the wage by the number of hours for which you are paid.

Example Margaret Kramer is a waitress in a restaurant. She works 2 hours every day after school 5 days each week, and in addition 7 hours on Saturday. Margaret receives $15.00 per week. What is her hourly rate?

What to Do	How to Do It
(1) Find the number of hours worked each week	5 × 2 = 10 hours after school + 7 hours on Saturday 17 hours each week
(2) Divide the weekly wage by the number of hours worked	$ .882 17)$15.00
(3) Round off the quotient	$.882 = $.88 Answer
(4) Check your computation	17 × $.882 = $14.994 = $15.00 Check

PROBLEMS

1. Charles Leonard works as an usher in a theater 5 hours each evening, 6 days per week and receives a wage of $22.50. How much is his average hourly wage?

2. Harold Davis has a job on a truck farm during his summer vacation. He works 9 hours per day, 5 days per week, and receives $35.10. What is his average hourly wage?

3. Fred Dronzek works on a farm after school 5 days each week, 3 hours each day, and also 8 hours on Saturday. His total wages for the week are $18.86. What is his average hourly wage?

4. Howard Whipple has a job as a counter man in a restaurant after school and on Saturdays. He works $1\frac{1}{2}$ hours each of 5 school days and $8\frac{1}{2}$ hours on Saturday. He is paid \$14.00 per week. What is his average hourly wage?

5. Katherine Fowler is a sales girl during her summer vacation. Each day she reports to work at 9:00 A.M. and stops work at 5:00 P.M. and has an hour off for lunch. She works 6 days each week and receives \$34.44.

a. How many hours does she work each week?
b. What does she receive per hour?

6. James DeVore had a holiday job at the post office. Each night he worked from 5:00 P.M. to 11:30 P.M. In all he worked 15 nights and earned a total of \$78.00. Find his average hourly rate.

7. One summer John O'Day made deliveries for a dental laboratory. At the end of 9 weeks he had earned \$288. He worked 40 hours each week.

a. Find his weekly wage.
b. Find his average hourly wage.

8. In eight weeks of his vacation last summer Joe earned \$252 doing assembly work making boxes. He worked 38 hours each week.

a. How much did he earn each week?
b. How much did he earn each hour?

9. Roy Glaze had a job last summer as a general laborer in a steel mill. He worked 8 hours a day and 5 days a week. His total earnings for 8 weeks were \$336.

a. How much did he earn each week?
b. How much did he earn each day?
c. How much did he earn each hour?

10. Last summer Dick Hallah worked on his uncle's farm for 8 weeks. He averaged 9 hours per day for 6 days each week. His total earnings for the summer were \$259.20.

a. Find his average weekly wage.
b. Find his average daily pay.
c. Find his average hourly wage.

WIDE WORLD

Odd jobs, such as mowing lawns, and business ventures, such as the collection and sale of waste paper, are open to students who have the stick-to-it-iveness to work on their own, and who offer services that other people need.

Odd Jobs and Small Businesses

Perhaps the greatest number of student workers earn their money doing odd jobs. A smaller number run small business enterprises of their own. The earnings of students in both groups depend to a large extent on their own initiative. Those who plan well and work hard often gain considerably in money and experience. On the other hand, those who plan poorly and fail to hustle make very little or even lose money.

Odd Jobs

Odd jobs include such work as mowing lawns, washing cars, and baby-sitting. A high-school student who is willing to do such jobs well often finds himself offered more work than he has time to accept. In addition to earning money, he gains valuable and varied work experience.

PROBLEMS

1. One week Robert Morgan earned $1.35 mowing Mrs. Foster's lawn; $2.20 washing windows for Mrs. Holt; $.75 washing Mrs. White's dog; and $.50 running errands. How much did he earn during the week?

2. Wilbur lives on a farm and sometimes earns extra money doing odd jobs for the neighbors. One month he received $15.75 for shocking oats for Mr. Dickson. During the same month, Mr. Law found it necessary to be away for a few days and paid Wilbur $4.75 for doing chores while he was gone. At another time during the month he helped Mr. Page do some painting and received $8.50. How much did he receive that month in all?

3. One week Harold received $1.75 for taking care of Mr. Scott's furnace; $.75 for cleaning another neighbor's basement; and $1.25 at one time and $2.35 at another time for shoveling snow. Find his total earnings for the week.

4. Anna owned a typewriter and used it to earn money typing for others. One month she received the following amounts for her work: $.75; $4.25; $.90; $1.25; $.75; $.50; $2.15; and $1.85. How much did she earn during the month?

During the ice-cutting season, these girls work hard and have fun while earning money for future needs.

5. William received $3.75 for spading the garden; $2.80 for cleaning and spading the flower beds; $1.50 for fertilizing the lawn; and $2.25 for trimming the hedge. Find the total amount he was paid.

6. One week Sylvia earned $1.75 for doing clerical work for a teacher outside of school hours; $.50 for watching a younger brother; $.35 for running an errand; and $2.75 for assisting in a beauty shop on Saturday. Find the total amount she earned.

GALLOWAY

Baby-sitting, a dignified job for both boys and girls, offers a chance to learn skills you are likely to need in later life.

7. A record of Thomas Bartow's earnings during one month showed that he had received $4.50 for waxing Mr. Hartwell's car; $11.85 for caddying at a golf course; $10.50 for washing cars at a garage; and $7.50 for mowing lawns. What were his total earnings that month?

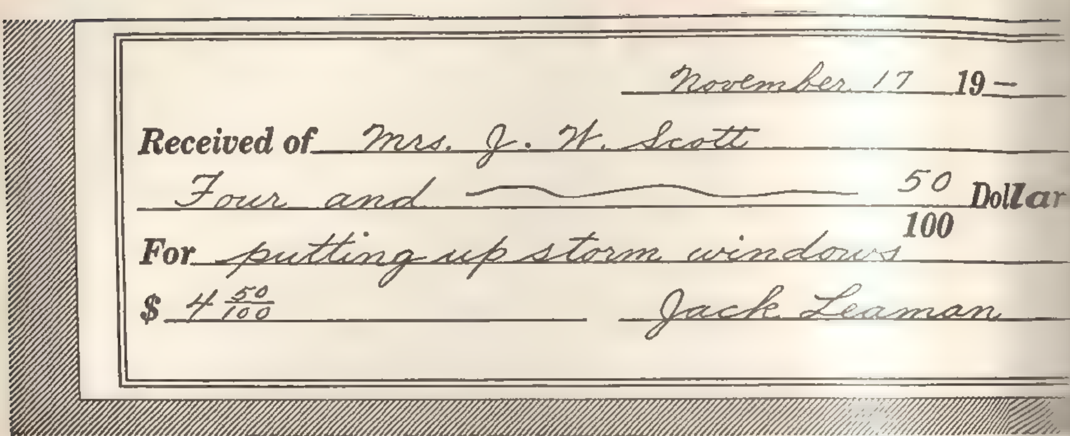
8. Thomas Davenport earns spending money picking strawberries, blackberries, raspberries, and cherries. One season he received the following amounts: $3.15; $1.60; $2.85; $5.65; $1.95; and $2.40. Find the total he received.

9. One fall Edward found eight different jobs raking leaves. He collected the following amounts for his work: $.75; $1.25; $.65; $1.50; $1.25; $.85; $.75; $1.75. Find the total amount he received for his work.

10. During the month of July, Mary earned money to go on a camping trip in August. Her record showed that she had done the following work:

Date	*Job*	*Amount*
July 1	Took care of Mrs. Baxter's children	$1.50
July 6	Did Mrs. Allen's ironing	1.50
July 8	Took care of Mrs. Baxter's children	1.75
July 10	Ran an errand for Mrs. Smith	.50
July 11	Did extra housework for mother	1.00
July 15	Took care of Mrs. Baxter's children	1.25
July 20	Did Mrs. Allen's ironing	1.50
July 22	Took care of children for Mrs. Jones	1.50
July 23	Cleaned house for mother	1.00
July 24	Washed windows for Mrs. Adams	1.75
July 25	Ran an errand for Mrs. Smith	.50
July 29	Took care of Mrs. Baxter's children	1.75

How much did she earn in all?


November 17 19—

Received of Mrs. J. W. Scott

Four and $\frac{50}{100}$ Dollar

For putting up storm windows

$ $4\frac{50}{100}$ Jack Leaman

Figure 3-1

How to Write Receipts

When you do odd jobs, you are usually paid in cash. Whenever anyone gives you money, you should give a receipt for it. The receipt should show *who* paid you, *how much* you received, and *for what* you were paid. You should date the receipt and sign it. Figure 3–1 shows a receipt. You can, if you wish, buy books of such forms for a few cents.

PROBLEMS

Use the form in Figure 3–1 for each of the required receipts.

1. Yesterday Walter Daly waxed floors and washed windows for Mrs. G. P. Carr. She paid him $5.25. Write a receipt such as Walter gave Mrs. Carr.

2. Bill Simonds washed and waxed Mrs. D. P. Welch's car on October 12. She paid him $12.50. Show the receipt Bill gave her.

3. Mrs. E. C. Layton pays you $.35 an hour for "sitting" with her baby after he has been put to bed. Last week you spent a total of 9 hours at this job. Today she paid you in full for your week's services. Write a receipt for Mrs. Layton.

4. Harold Haynes charges $.75 an hour for shoveling snow. During January he cleared the walks around Mrs. Thomas

Dean's house each time it snowed, working for her a total of 18 hours. She paid him in full on February 1. Write a receipt such as Harold gave Mrs. Dean.

5. Joe Wiley charges $.80 an hour for mowing lawns, clipping hedges, etc. During August he spent 24 hours caring for Mr. Ernest Fisher's lawns. Mr. Fisher paid him in full on September 2. Show the receipt Joe gave him.

Small Business Enterprises

Anyone in business for himself must keep a careful account of his expenses and his receipts. To find his profit, he must know (1) how much money was received, and (2) how much money was spent. Then he must subtract the total expenditures from the total receipts.

Example

Harry Robbins has a garden patch and sells the vegetables he grows from a small stand which he built from old lumber. His father lets him use the land without charge. Last summer, his expenses were as follows: plowing, $5.00; fertilizer, $4.50; seeds, $7.50; tools, $6.75. At different times his receipts amounted to: $3.25; $.85; $4.15; $2.75; $1.85; $5.75; $10.65; $.75; $3.30; $8.25; $1.85; $8.95; and $3.85. Find his total profits.

What to Do	How to Do It
(1) Find the total of the amounts received at different times.	Sum = $56.20 Total Receipts
(2) To find the total amount spent, add all expenses.	Plowing $5.00 Fertilizer 4.50 Seeds 7.50 Tools 6.75 $23.75 Total Expenses
(3) To find the profit, subtract the total expenses from the total receipts.	Total Receipts $56.20 Total Expenses − 23.75 Profit $32.45 Answer

PROBLEMS

1. Stella engraves leather goods and has them sold at a novelty stand. She must buy the leather and a few tools, and she must pay the owner of the novelty stand a fee for selling the goods. Last summer she spent \$10.75 for tools; \$18.75 for leather; and paid the owner of the stand \$16.20. Her total sales were \$108.00. How much did she make?

2. Richard Riley rents a number of small boats which he in turn rents to residents at a summer resort. During the season he paid \$35 for the rent on the boats and for the use of the dock. In addition he spent \$15.75 painting the boats and keeping them in repair. He charged \$.25 per hour to the people who used the boats. The boats were in use as follows:

The month of June 228 hours
The month of July 375 hours
The month of August 385 hours

What were his total profits for the summer?

3. John's father advanced him the money to buy 6 lambs at \$10.00 each. John's expenses for the lambs for three months were as follows:

Two enterprising students are shown below: the boy is running a construction company of his own; the girl has started a sandwich service.

WIDE WORLD

Feed: 9 bushels of corn at $1.30 per bushel
500 pounds of hay at $25 per ton (2000 pounds = 1 ton)
100 pounds of supplementary feed, $5.50

At the end of three months the total weight of the lambs was 540 pounds. John sold them at $20.50 per 100 pounds. After paying back the money he had borrowed, what was John's profit?

4. Harold bought a steer calf for $65.00. Seven months later it weighed 815 pounds, and was sold at $22 per 100 pounds. Harold's expenses were as follows:

38 bushels of corn at $1.18 per bushel
500 pounds of hay at $22 per ton (2000 pounds = 1 ton)
Silage and supplementary feed, $21.50

How much did he make on the calf?

5. David's father gave him a brood sow and told him he could have the money he made on the first litter of pigs if he paid for all the feed consumed. The following is a summary of David's account:

65 bushels of corn at $1.25 per bushel
3½ bushels of oats at $.75 per bushel
5 bushels of other grain at $1.25 per bushel
215 pounds of protein supplement at $5.20 per 100 pounds
Raised 6 pigs, average weight 200 pounds.
Received for pigs $19.25 per 100 pounds.

Find his net profit.

6. Frances Burns bought 72 metal baskets at $.21 each and 72 baskets at $.42 each. She decorated the baskets and sold them for waste baskets. The paint and other materials cost her $22.50. She received the following prices: 22 baskets at $.70 each; 50 baskets at $.50 each; 20 baskets at $1.40 each; 40 baskets at $1.25 each; and 12 baskets at $1.75 each. What were her total profits?

7. Stephen Moore delivers newspapers every morning to 53 customers. He pays 4 cents for each paper delivered on the 6 week days and 12 cents for each Sunday paper. He collects 5 cents for each daily paper and 15 cents for each Sunday paper. How much does he earn from his paper route each week?

8. Harriet sells Christmas cards. During the months of October, November, and December the record of costs and sales were as follows:

Number of Boxes	*Cost per Box*	*Selling Price per Box*
15	$.52	$1.00
25	.40	.75
20	1.35	2.50
30	.75	1.50
50	.63	1.25

What were her total profits?

9. During his Christmas vacation Robert Cook worked in a warehouse of a department store loading and unloading packages. He worked 11 days, 8 hours each day and received $.90 per hour. In his spare time he makes fishing plugs to sell during the summer to fishermen at a resort. Last year he spent $33.00 for materials and made the following sales: 25 plugs at $.35 each; 57 plugs at $.50 each; 62 plugs at $.45 each; 75 plugs at $.55 each. Find his total earnings from the fishing plugs and his Christmas job.

10. During 48 weeks of the year, Mary Allen works 8 hours each Saturday as a sales girl in a department store. She receives $.75 per hour. She also keeps a flock of hens. Her accounts for one year showed an income of $280.00 from the sale of eggs and expenses as follows:

17 bushels of corn at $1.21 per bushel
8 bushels of wheat at $2.05 per bushel
10 bushels of oats at $.73 per bushel
1500 pounds of mash at $4.25 per 100 pounds

How much did she earn during the year?

How Workers Are Paid

Many workers are paid on the basis of the time they spend on the job. Others are paid according to the amount of work they do, regardless of the time required to do it. In either

case, pay is figured before deductions for income tax and the like are made. Earnings before deductions are called *gross income.*

Hourly Pay

Among the workers who are paid according to the number of hours they work are carpenters, electricians, and mechanics. The hourly rate applies to the time the worker spends on the job, up to a certain number of hours per week or per day. If he spends more than that length of time, he receives a higher rate of pay.

The rate of pay for *overtime* is, quite generally, $1\frac{1}{2}$ times the basic rate. Sometimes twice the basic rate is paid for work done on Sundays or holidays.

Example

In a certain town bricklayers are paid $1.60 an hour for a 40-hour week. They receive "time and a half" for overtime work. What would be the gross income of a bricklayer in this town for a week in which he worked 48 hours?

What to Do	How to Do It
(1) Find how much is earned at the regular rate of pay	$1.60 × 40 = $64.00
(2) Find the rate of pay for overtime	$1\frac{1}{2} \times \$1.60 = \$2.40$
(3) Find the number of hours of overtime	48 − 40 = 8
(4) Find the amount earned at the overtime rate	$2.40 × 8 = $19.20
(5) Add the amount earned during the regular work week and the amount earned in overtime	$64.00 + 19.20 = $83.20 **Answer**

PROBLEMS

1. Paul Westcott earns $1.20 an hour working in a factory that makes iron and steel forgings. He receives time and a half for all time over 40 hours a week. One week he worked 45 hours. What was his gross income that week?

2. A plasterer is paid $2.00 an hour for a 40-hour week with time and a half for overtime. What is his gross income in a week in which he works 44 hours?

3. James Watson is a plastic mold maker in a pottery plant at $1.62 an hour. He works 40 hours a week for 51 weeks each year and has a week's vacation on full pay. What is his gross yearly income?

4. George Evans is a baker who is paid $1.52½ an hour, 40 hours a week. He works 50 weeks a year, and has two weeks vacation on full pay. What is his gross yearly income?

5. Harvey Landers is an electrician who receives $1.50 an hour, with time and a half for overtime. The standard work week is 40 hours. If Mr. Landers works 42 hours a week for 48 weeks a year, and takes 4 weeks off, what is his gross yearly income?

This man is showing how to "punch" a time clock. The time a worker arrives and the time he leaves are recorded on his time card.

LAMBERT

6. Martin Taylor is a spray painter in a pottery plant. He works 51 weeks a year. He receives $1.15 an hour for a 40-hour week. He averages 4 hours a week overtime at time and a half. What is his gross yearly income?

7. Paul Harter drives a delivery truck for a wholesale grocery company. He receives 90 cents an hour. His regular work week consists of 8 hours a day, 5 days a week, and 4 hours

on Saturday. He receives time and a half for any extra time he puts in on week days, and double time for work on Sundays and holidays. One week recently he worked 8 hours a day for six days and 4 hours on Sunday. How much was his gross income that week?

8. Michael Kelly is a tool and die maker who is paid $1.50 an hour, 40 hours a week. He receives time and a half for the extra time he works on week days and double time for work done on Sundays. One week he worked 8 hours a day for 6 days and 5 hours on Sunday. How much was his gross income that week?

9. Copy and complete the following record of work on a construction job. Time and one half is allowed for overtime and 40 hours is considered a full week.

Name	*Hours Worked*	*Regular Time*			*Overtime*		*Gross Pay*
		Hr.	*Rate*	*Amt.*	*Hr.*	*Amt.*	
C. N. Jones	47	40	$ .90	$36.00	7	$9.45	$45.45
H. N. Meyers	38		1.10				
J. W. Adams	44		.96				
R. E. Walker	46		1.17				
T. O. Harvey	50		.88				

10. Copy and complete the following employee record. Consider 40 hours as a full week. Overtime is paid at the rate of $1\frac{1}{2}$ times the regular rate.

Name	*Hours Worked*						*Regular Time*			*Overtime*		*Gross Pay*
	M	*T*	*W*	*T*	*F*	*S*	*Hr.*	*Rate*	*Amt.*	*Hr.*	*Amt.*	
J. R. Stone	9	8	8	8	9	4	40	$1.50	$60.00	6	$13.50	$73.50
C. W. Tann	8	8	9	9	9	4		1.60				
T. R. Black	8	8	8	8	8	4		1.25				
H. C. Smith	9	9	8	8	9	4		.90				
M. R. Cooke	8	8	8	8	9	5		1.10				

Salaries and Commissions

Some workers are paid a *salary;* that is, a fixed amount per week, month, or year. Some workers are paid a *commission;* that is, a certain percentage of the amount of their sales or the amount of money taken in for their employer. Still other workers are paid both a salary and a commission. The commission may be a percentage of all the money they take in or it may apply only to the money taken in above a fixed amount.

Example Ronald Eliot works in a hardware store at a salary of $25.00 a week plus a commission of 3% on all his sales in excess of $500.00 a week. How much does he earn in a week when his sales amount to $814.00?

What to Do	How to Do It
(1) Find the amount on which a commission is paid.	$814 − 500 $314
(2) Find the amount of the commission.	$314 × .03 $9.42
(3) Add the amount of the commission to the salary.	$9.42 25.00 $34.42 Answer

PROBLEMS

Since some of the following problems are about salaries, some about commissions, and some about salaries plus commissions, be sure to read each problem carefully.

1. Frank Baker receives a salary of $18 a week as a barber. In addition he receives a commission of 50% of the money taken in for his work above $25. One week he took in $54.75. How much was his pay that week?

2. Claude Miller is a salesman in a shoe store. He receives a salary of $37.50 a week plus a commission of 2% on all his sales in excess of $600 a week. How much does he earn in a week when his sales amount to $928?

3. Janice Clay, a recent graduate from high school, is secretary in a real estate office at $32.75 a week. She works 50 weeks a year, and has two weeks vacation with pay. What is her annual income?

4. Grace Bradley graduated from high school and immediately obtained employment as a secretary in a law office. Her salary now is $38.25 a week. She has a paid vacation of two weeks each year. What is her yearly income?

5. James Hanson is a driver on a bakery wagon and is paid 15% commission on his sales. In June, he sold $1034.50 worth of baked goods.

a. How much did he earn that month?

b. What was his average weekly income? ($4\frac{1}{3}$ weeks = 1 month)

6. Mr. Cox is a haberdashery salesman who receives a commission of $6\frac{1}{2}$% on his sales. During October he sold $4640 worth of goods.

a. What was his income for October?

b. What was his average weekly income? (Consider a month as $4\frac{1}{3}$ weeks.)

7. Mr. Haviland receives a base salary of $25 a week and a commission of $2\frac{1}{2}$% on all his sales. One week his sales were as follows: Monday, $560.80; Tuesday, $621.45; Wednesday, $400.10; Thursday, $718.45; Friday, $447.60; and Saturday, $345.00. How much did he earn that week?

The neat appearance and serious attitude of this young man are points in favor of his getting the salesman's job for which he is applying.

PIX

8. Mr. Brigham's base salary is $27.50 a week. His commission is $2\frac{3}{4}\%$ on all his sales. How much did he earn in a week when his sales were as follows: Monday, $675.50; Tuesday, $730.20; Wednesday, $593.50; Thursday, $821.30; Friday, $697.40; and Saturday, $547.70?

9. Earl Wilson drives a cab for the Ace Cab Company. He receives as pay $42\frac{1}{2}\%$ of the money he takes in as fares plus all the tips he receives. One week he took in $108.60 in fares and received $12.85 in tips.

a. What did Earl's earnings amount to that week?

b. If that week can be considered as typical, what monthly income can he expect? ($4\frac{1}{3}$ weeks = 1 month)

c. If the week described is typical, how much does Earl earn in a year during which he works 51 weeks?

10. Betty Perkins has a position as a beauty operator. Her weekly income includes a salary of $23.50, a commission of 40% of all she takes in above $60 and all the tips she receives. During a recent week she took in $79.25 for her work and received $7.65 in tips.

a. What did Betty's earnings amount to that week?

b. If the week described is typical, what monthly income can Betty expect? ($4\frac{1}{3}$ weeks = 1 month)

c. If the week described is a typical one, how much does Betty earn in a year during which she works 50 weeks?

Piecework

Under the *piecework* plan, a worker may receive a stated number of cents for each article he makes in a factory or for each quart of berries he picks for a fruit grower, or the like. Thus the faster he works the more money he earns.

PROBLEMS

Some of the problems that follow contain more information than you need to use in solving them. Do not let them mislead you.

1. Louis Cramer assembles the parts of wooden toys in a toy factory. For each toy he assembles he is paid 24 cents. One week he worked 40 hours and assembled 196 toys. How much did he earn that week?

2. A factory worker on piecework is paid $3\frac{1}{4}$ cents for each article he makes. He makes an average of 1060 articles in a 40-hour work week. Find his average weekly earnings.

GALLOWAY

The man in this picture is a piece worker in a shoe factory. Cutting the leather pieces requires accuracy at all times.

3. Mary Elders receives 17 cents for each apron she finishes on a power sewing machine. Find her wages for a week if she completes 40 aprons on Monday, 39 on Tuesday, 42 on Wednesday, 43 on Thursday, and 37 on Friday.

4. During the months of August and September, Henry Morning picks tomatoes for a canning factory. He receives 14 cents a bushel. Find his earnings during a week in which he picked 58 bushels Monday, 63 bushels Tuesday, 63 bushels Wednesday, 65 bushels Thursday, 60 bushels Friday, and 57 bushels Saturday.

5. Robert Langer washes cars in a large service station. He receives 90 cents for each car he washes. In March, he worked 26 days, 7 hours a day, and averaged 8 cars a day.

a. What was his average pay per day?

b. How much did he earn that month?

6. Anne Newman irons shirts in a laundry. She receives 8 cents for each shirt she irons. She irons an average of 52 shirts a day and works 8 hours a day 5 days a week.

a. How much does she earn in a day?

b. How much would she earn in a week?

7. Leroy Schultz is a metal polisher in a factory that manufactures plumbing fixtures. For polishing a certain faucet for a kitchen sink he receives $6\frac{1}{2}$ cents. How much does he earn in a day when he polishes 148 faucets?

8. Frank Merton works as a wood finisher for a company that makes furniture. He receives $1.47\frac{1}{2}$ for finishing and polishing a certain kind of table top. How much does he earn during a week in which he finishes and polishes 40 of these table tops?

9. Martha Holen operates a power sewing machine. She sews together the pieces of material to make women's dresses of various kinds. One week recently she worked 44 hours. The number of dresses she worked on that week and the pay received for each is shown below. How much did she earn that week?

Number of Dresses	*Pay for Each Dress*
41	$17\frac{1}{2}$ cents
56	25 cents
23	$42\frac{1}{2}$ cents
28	53 cents

10. Verner Jansen is a spray painter in a factory that makes lawn furniture. He paints several different pieces of furniture. Below are shown the number of pieces painted one week, during which he worked 42 hours, and the pay received for each. How much did he earn that week?

Number of Pieces	*Pay for Each Piece*
37	$27\frac{1}{2}$ cents
43	36 cents
98	19 cents
72	$12\frac{1}{2}$ cents

A pay envelope carries a statement of deductions from the worker's wages.

LAMBERT

Deductions from the Pay Envelope

A worker does not actually receive all the money he earns. Some of it goes directly to the government as payment on his income tax and as social security payment. Sometimes he authorizes his employer to buy United States Savings Bonds for him, or to deduct money to pay union dues, hospitalization dues, or insurance premiums.

Example

Thomas Stafford earns $42.50 a week. His employer makes the following deductions from his weekly pay envelope: social security, $.64; income tax, $1.60; hospitalization, $.30; and United States Savings Bonds, $2.50. What is the amount of Mr. Stafford's take-home pay each week?

What to Do	How to Do It
(1) Find the sum of all the weekly deductions.	$ .64 1.60 .30 2.50 $5.04
(2) Subtract the weekly deductions from the weekly earnings.	$42.50 − 5.04 $37.46 Answer

PROBLEMS

1. Mrs. Morgan receives $28 a week for working in a laundry. Her employer makes the following deductions from her weekly pay: income tax, $4.30; social security, $.42; and hospitalization, $.20. What is the amount of Mrs. Morgan's weekly take-home pay?

2. William Moore is a machinist who earns $59.40 a week. The deductions from his weekly pay envelope include: income tax, $5.10; social security, $.89; hospitalization, $.25; and union dues, $.50. What is the amount of Mr. Moore's weekly income after all deductions have been made?

3. Anne Douglass is a stenographer. She is paid $75, twice a month. The following deductions are made from each of her pay checks: social security, $1.13; income tax, $7.10; and hospitalization, $.75.

a. What is the amount of each of her pay checks after deductions have been made?

b. What is the amount of her annual take-home pay?

4. Arthur Barton is a public school teacher who is paid a salary of $240 a month, 9 months a year. Two deductions are made from his monthly pay: $12.00 for the teachers' retirement system, and $11.60 for income tax.

a. What is Mr. Barton's monthly take-home pay?

b. What is his annual take-home pay?

5. Henry Stoner is a clerk in a department store. He is paid $32.50 a week. The deductions from his weekly pay are: income tax, $4.90; social security, $.49; hospitalization, $.20; and United States Savings Bonds, $3.75. How much does he receive in his pay envelope each week?

6. Wilbur Morris is a cataloguer in a library. He earns a salary of $2700 a year, payable in 12 equal monthly payments. Every month $8.90 is deducted from his pay for income tax, $3.38 for social security, $7.50 for a United States Savings Bond, and $1.50 for hospitalization.

a. How much pay does he receive each month after deductions have been made?

b. What is his annual take-home pay?

7. George Simmons has a position as bookkeeper and accountant in a factory that makes electrical equipment. He earns $3250 a year, payable twice a month. Every payday the following deductions are made from his pay check: income tax, $16.20; United States Savings Bonds, $6.25; social security, $2.03; and hospitalization, $.75. What is the amount of his pay check after deductions have been made?

8. Arnold Mueller has a position as teller in a bank. His salary is $2040 per year, payable twice a month. Every payday his employer makes these deductions from his pay: income tax, $4.40; social security, $1.28; hospitalization, $.75; and United States Savings Bonds, $3.00. What is the amount of Mr. Mueller's take-home pay every payday?

9. A machine operator in a factory that makes automobile parts earns $70.31 a week. Every week the following deductions are made from his pay envelope: income tax, $6.80; social security, $1.05; and United States Savings Bonds, $3.00. He has made arrangement with his employers for a deduction of $15.00 from his pay for the first week in October as a con-

tribution to the community fund. A deduction of $18.00 is made from his pay the first week in January to pay his annual union dues. What is his weekly take-home pay:

a. The first week in January?
b. The first week in April?
c. The first week in October?

10. Alice Flynn is an assistant store manager whose monthly salary is $237.50. Every month the following deductions are made from her pay check: income tax, $27.30; social security, $3.57; United States Savings Bonds, $18.75. She has authorized two further deductions, one of $12.50 in October for her contribution to the community fund and one of $5.00 in February for her Red Cross contribution. What is her take-home pay:

a. For the month of October?
b. For February?
c. For May?

Average Wages and Rates

What you do for a living has a lot to do with how much money you earn. Of course this does not mean that all farmers or all physicians earn the same amount of money. Some farmers have a very small income while others earn much more, and the same is true of doctors. But the *average* earnings of farmers are less than the *average* earnings of physicians, although some farmers earn more than some doctors.

Average Earnings

Average earnings are found from the total incomes of large groups of workers. The total income is divided by the number of workers in a given occupation. An average found in this way is called a *mean*, and the average wage is called the *mean wage*. (You will learn about averages found in other ways in Chapter 14.)

Example

One week in September there were 1,660,000 persons employed in the iron and steel industry. Their combined earnings were \$85,000,000. What was the average (mean) weekly income?

What to Do	How to Do It
(1) Divide the total income by the number of workers.	$166.0000\overline{)8500.0000}$ = 51.204
(2) Express the quotient to the nearest cent.	Mean weekly income = \$51.20 Answer
(3) Check the answer by multiplying.	51.204 × 1660 000 = 84998640.000 = \$85,000,000 Check

PROBLEMS

In solving these problems, which deal with large numbers, remember that you can make your work easier by first dividing both dividend and divisor by the same power of ten. (Move the decimal point the same number of places to the left in each figure.)

1. During one of the war years, 16,200,000 persons employed in the manufacturing industries earned a total of \$33,300,000,000. Find the average (mean) annual income of employees in this group.

2. The total annual earnings of 700,000 persons employed in mining industries were \$1,700,000,000. Find the average (mean) annual income of employees in this group.

3. The total earnings of persons employed in transportation and public utilities one year were \$8,400,000,000. The number of persons employed was 3,500,000. What was the average annual income of persons in this group?

4. About ten years ago, the number of teachers, supervisors, and principals in the public schools of the United States was 875,000. Their combined annual salaries amounted to \$1,314,340,000. Find the average annual salary of the members of this group to the nearest dollar.

5. One year when the Army personnel totalled 7,734,000, the total amount spent by the government on Army pay was \$12,913,274,000. What was the average (mean) annual pay of persons in the Army that year?

Average Hourly Rates

Published reports often tell the average weekly earnings of workers in various trades, and the average number of hours worked per week. From these facts you can find the average hourly rates of pay.

Example One April, the average (mean) weekly earnings of employees in industries that make electrical equipment was \$50.34. The average number of hours worked per week was 40.2. Find the average hourly rate of pay.

What to Do	How to Do It
(1) Divide the average weekly earnings by the average number of hours worked.	$\begin{array}{r} 1.2522 \\ 40_{\wedge}2.\overline{)50_{\wedge}3.4000} \end{array}$
(2) Express the quotient to the nearest tenth of a cent.	Average hourly rate = \$1.252 Answer
(3) Check the answer by multiplying.	$\begin{array}{r} 1.2522 \\ \times\ 40.2 \\ \hline 50.33844 \end{array} = 50.34$ Check

PROBLEMS

The following problems are based on earnings in a recent year. In each case, find the answer to the nearest tenth of a cent. Check your work.

1. If the average weekly wage of persons employed in the manufacture of boots and shoes was \$38.06 and the average number of hours worked per week was 37.9, what was the average hourly rate of pay?

2. When the average weekly pay of employees in industries manufacturing farm machinery was $51.93, and the average number of hours worked per week was 40.5, what was the average hourly rate?

3. Find the average hourly rate at which employees of companies publishing newspapers and periodicals were paid, when the average weekly wage was $65.29, and the average number of hours worked per week was 38.9.

4. According to a report of the United States Department of Labor, workers engaged in the mining of bituminous coal earned an average of $64.90 weekly and worked an average of 43.7 hours each week. What was the average hourly pay?

5. Copy and complete the table that follows.

AVERAGE WEEKLY EARNINGS, HOURS WORKED PER WEEK, AND HOURLY RATES OF PAY OF EMPLOYEES OF PUBLIC UTILITIES COMPANIES, 19—

Public Utility	*Average Weekly Earnings*	*Average Weekly Hours*	*Average Hourly Rate*
Telephone	$43.19	38.0	
Electric light and power	$54.43	41.0	
Street railways and buses	$55.82	47.8	

6. Copy and complete the table below.

AVERAGE WEEKLY EARNINGS, HOURS WORKED PER WEEK, AND HOURLY RATES OF PAY OF WORKERS IN THREE RETAIL TRADES, 19—

Retail Trade	*Average Weekly Earnings*	*Average Weekly Hours*	*Average Hourly Rate*
Food	$42.12	39.9	
Lumber and building materials	$44.91	42.9	
General merchandise	$29.91	36.0	

7. The average weekly income of employees in industries manufacturing men's clothing was $40.16, and the average number of hours worked per week was 36.6. What was the average hourly pay?

8. The average weekly wage of persons employed on a year-round basis in hotels was $29.09 and the average number of hours worked per week was 44.7. What was the average hourly rate?

9. The average weekly earnings of employees in sawmills and logging camps one November was $36.26. The average number of hours worked per week was 40.1. Find the average hourly rate.

10. One November, the average weekly pay of workers engaged in the manufacture of plumbing supplies was $77.32. The average number of hours worked per week was 40.1. What was the average hourly rate?

Average Weekly and Monthly Wages

Sometimes reports show the average rate of pay of a group of workers and the average number of hours worked. From this information you can find the average earnings per week, month, or year.

Example One September, the average wage for carpenters was $1.473 per hour and the average number of hours worked per week was 39.8. Find the average monthly wage ($4\frac{1}{3}$ weeks = 1 month).

What to Do	How to Do It
(1) Multiply the average hourly wage by the average number of hours worked per week.	$1.473 × 39.8 $58.6254
(2) Express the product to the nearest cent.	Average weekly wage = $58.63
(3) Multiply the weekly wage by $4\frac{1}{3}$.	$4\frac{1}{3} = \frac{13}{3}$ $\frac{13}{3} \times \$58.63 = \$254.06$ Answer

PROBLEMS

The following problems are based upon United States government reports. Unless otherwise stated, consider a work week equal to 40 hours and a month equal to $4\frac{1}{3}$ weeks.

1. During a recent year the average wage received by workers engaged in the manufacture of rubber products was $1.32 an hour. How much did these workers receive per month?

2. One October the average hourly wage of electricians in housing construction was $1.551. If this wage was typical of the entire year, what was the average annual income of these workers?

3. Copy and complete the table that follows.

AVERAGE NUMBER OF HOURS WORKED PER WEEK AND AVERAGE HOURLY, WEEKLY, AND MONTHLY EARNINGS OF WORKERS IN FOUR INDUSTRIES, 19—

Industry	*Average Hourly Earnings*	*Average Weekly Hours*	*Average Weekly Earnings*	*Average Monthly Earnings*
Machine-shop products	$1.249	41.1		
Engines and turbines	1.372	40.6		
Farm machinery	1.268	39.8		
Machine tools	1.317	42.5		

4. In a recent year, unskilled laborers engaged in road building were paid an average hourly wage of $.98 in the middle Atlantic region and an average hourly wage of $.68 in the south Atlantic region. How much more was the average monthly pay of a laborer of this classification in the middle Atlantic region than in the south Atlantic region?

5. In a recent year, the average hourly rate for unskilled workers on roads was $1.19 in the Pacific region and $.95 in New England. How much more was the average weekly pay of an unskilled road worker on the Pacific coast than the average weekly pay of an unskilled road worker in New England?

What You Have Learned in This Chapter

1. To find the amounts earned in various part-time jobs
2. To find the amounts earned by workers who are paid at a fixed rate per hour, week, or month
3. To figure the earnings of those who work on commission
4. To figure the income of workers who are paid according to the piecework plan
5. To compute the income of workers receiving overtime pay
6. To find the difference between gross pay and take-home pay, when deductions are known
7. To determine the average earnings of persons in various occupations from the total income of large groups of workers and the number of workers in the group
8. To find hourly rates from weekly pay and number of hours worked
9. To determine the average rates of pay in various jobs
10. To understand and use correctly the following terms: *gross income, overtime, salary, commission, piecework, mean*

Skill counts in earning money. The arc welder commands higher wages than the street cleaner.

MBERT BLACK STAR

Review Test on Earning Money

1. Sam Reed worked in a manufacturing plant during the 38 weeks of the school year. He worked 3 hours after school each of 5 days and 8 hours on Saturday. His pay was \$.75 per hour. During the summer he earned money from his garden. He had the following expenses: plowing, \$7.50; seeds, \$6.50; baskets, \$3.25; fertilizer, \$6.75. His sales were as follows: \$3.75; \$10.85; \$1.75; \$7.35; \$4.15; \$.95; \$9.95; \$6.50; \$2.10; \$3.25; and \$1.50.

a. How much did Sam earn at his job during the school year?

b. How much did he earn from his garden?

c. What was his total income?

2. Frances Taylor is a waitress in a restaurant. She works 3 hours after school 5 days each week and 8 hours on Saturday. She receives \$17.25 per week. What is her average hourly pay?

3. One month James earned \$2.75 helping a neighbor build a fence, \$5.50 plowing corn, and \$7.50 working in a garden. He also delivered groceries for the West Side Market on the four Saturdays of the month. He worked for the market 9 hours each Saturday and received \$.75 per hour.

a. How much did James earn from his odd jobs?

b. How much did he earn from his regular Saturday job?

c. What was his total income that month?

d. Write a receipt such as James gave his neighbor, G. A. Kendall, when he was paid for his work on the fence.

4. George Allen drives a truck for a dairy. He is paid \$.85 an hour with time and a half for all time over 40 hours a week. How much does he earn in a week if he works 46 hours?

5. Alice Page sells children's ready-to-wear clothing in a department store. She receives a salary of \$28.75 a week. In addition, she is paid a commission of 2% on all her sales.

a. How much does she earn in a week when her sales amount to \$340.50?

b. If the week described is a typical one, what monthly income may Alice expect? ($4\frac{1}{3}$ weeks = 1 month)

6. David Fisher is paid \$.15 a bushel for picking peaches on a fruit farm. One week he picked 265 bushels. How much did he earn that week?

7. William Ashley earns \$50.75 a week as a lineman for a telephone company. One week these deductions were made from his pay: income tax, \$3.70; social security, \$.76; hospitalization, \$.75; United States Savings Bonds, \$3.75. What was the amount of his take-home pay that week?

8. During a war year, the entire military personnel of the United States totalled 11,608,000. The amount spent by the government on military pay that year was \$19,973,112,000. What was the average annual pay of persons in military service that year?

9. One November, the average weekly earnings of persons employed in the manufacture of silk and rayon goods were \$38.69. The average number of hours worked per week was 41.1. Find the average hourly rate to the nearest tenth of a cent.

10. The average hourly wage of workers engaged in the manufacture of ice cream was \$.976 in a certain November, and the average number of hours worked per week was 46.0. What was the average weekly wage?

How do you rate?	Excellent	Good	Fair	Poor
	10	9	7–8	6 or less

CHAPTER

4

KEYSTONE

Keep a record of your own income and of all your expenses while studying this chapter. Use a form such as the one on page 150. After you have kept a cash record for a while, use it to prepare a workable budget for yourself. Follow the plan on pages 157–158. Then draw up a budget record like the one on page 160.

ACCOUNTS AND BUDGETS

A BUDGET IS A PLAN for spending money wisely. If you plan well and follow your plan, you are almost sure to save money.

To make a budget, take these three steps:

(1) Keep a record of your income and your expenditures.

(2) Classify your expenditures and compare the totals with the amounts suggested in a standard budget.

(3) With both the standard and your own needs as guides, decide how you should use your money.

No budget is permanent. Your income may increase or decrease; prices may go up or down; your needs may change. A budget can and should be revised when circumstances change.

Budgets for High-School Students

Do you know where your money goes? If you do, you can usually plan your spending so that you can buy the things you want and need; if you do not, you are likely to find yourself "short" just when you should like to make some special purchase.

Keeping a Record of Income and Expenses

For most high-school students, a simple record of income and expenses is sufficient. Three facts should be recorded: the date, the item for which you spent or received money,

and the amount. Figure 4–1 is a page from a student's account book. It covers one week.

Notice the first item on the page: "Balance on hand." The balance on hand is the amount of money a person has at the beginning of the period covered by that page of his account book. This amount is entered in the column headed

Figure 4-1

CASH RECORD Week Beginning Nov. 3

Date		Explanation	Received		Paid	
Nov	3	Balance on hand	1	68		
		Allowance	3	00		
		Savings				60
		Lunch				30
	4	"High School High Lights"				50
		Lunch				37
	5	Lunch				42
		Movies				30
	6	Lunch				35
		Ink .11 Pencil .05				16
		From Mrs. Bell for "sitting"	1.	00		
		Savings				20
	7	Lunch				45
	8	From Mrs. Jacobs for "sitting"		75		
		Savings				15
		Candy .10 Soda .17				27
	9	Church				25
		Total Receipts and Payments	6	43	4	32
		Balance on Hand			2	11
			6	43	6	43

When you keep a record of your expenses, be sure to enter small amounts, such as the price of an ice cream cone.

"Received." The first item on every page of an account book should always be "Balance on hand."

Items of income, like the balance on hand, are entered in the "Received" column. Expenditures are entered in the column headed "Paid." So are savings. Savings are entered as money paid out because they are laid aside, and the money is not considered available for ordinary expenditures. One of the best ways to save money is to set aside a certain percentage of every amount you receive just as soon as you get it. Then you are not tempted to spend it on things you don't really need or even want very much.

At the end of the period covered by a page of an account book, the columns are added, and the totals are entered. Then the total payments are subtracted from the total receipts, and the difference is entered beneath the sum of the payments. (In Figure 4–1, \$4.32 is subtracted from \$6.43, and the difference, \$2.11, is written beneath \$4.32.) This difference is the new balance on hand. As a check, it is added to the total payments, and the sum is written beneath the new balance. (In Figure 4–1, \$6.43 is written beneath \$2.11.) So that a person can tell at a glance whether the accounts check, the sum of the receipts is "brought down"; that is, it is written again on a line next to the last entry in the payment column.

DEVANEY

You aren't likely to forget to note what you spend for a phonograph record, but nickels dropped in a juke box may slip your memory, unless you make a habit of writing down your expenditures daily.

PROBLEMS

Make out a cash record, such as the one shown in Figure 4–1, for the students whose receipts and expenditures are given below.

1. Joe Mills has a part-time job from which he receives $12.50 every Saturday. He immediately puts aside $2.50 as savings. He keeps his accounts on a weekly basis, beginning with Saturday. Before receiving his pay on Saturday, October 3, he had $3.78. His expenditures that week were as follows:

Saturday:	Movies for two, $1.20; refreshments for two, $.55
Sunday:	Church, $.50
Monday:	Car pass, $1.00; lunch, $.45
Tuesday:	Lunch, $.38; hair cut, $.90
Wednesday:	Lunch, $.50; chewing gum, $.05
Thursday:	Lunch, $.48; shoe repair, $1.50
Friday:	Lunch, $.53; bowling, $.50; snack, $.25

2. Mary Matson has a regular child-care job every Wednesday afternoon and evening, for which she is paid $2.50, and another every Saturday morning, for which she receives $1.75. She puts $.50 aside as savings every Wednesday and $.35 aside as savings every Saturday. She keeps her accounts on a weekly basis, beginning on Sundays. On Sunday morning, February 4, she had $2.13 on hand. Her expenses that week were as follows:

Sunday: Church, \$.25
Monday: Magazine, \$.25
Tuesday: Gift for her mother, \$1.25; wrappings, \$.15
Thursday: Notebook, \$.10; eraser, \$.05; basketball game, \$.30
Friday: Movies, \$.36; ice cream, \$.17
Saturday: Lipstick, \$.12

3. Harry Cox works 7 hours every Saturday and receives \$.75 per hour. He saves \$1.25 of his Saturday pay. He does clerical work for a teacher every Tuesday afternoon, for which he receives \$1.00. He keeps his accounts on a weekly basis, beginning with Monday. On Monday morning, November 8, Harry's balance was \$3.28. His expenditures that week were:

Monday: Lunch, \$.39; after-school dance, \$.15
Tuesday: Lunch, \$.33; candy, \$.05
Wednesday: Library fine, \$.06; lunch, \$.38; bowling, \$.35
Thursday: Lunch, \$.43; ice cream for two, \$.30
Friday: Lunch, \$.41
Saturday: Roller-skating for two, \$1.20; refreshments for two, \$.50
Sunday: Church, \$.25

4. Edward Smith works in a drug store 3 hours daily 5 days each week at \$.50 an hour. He is paid for this work on Fridays. On Saturdays he washes cars for the people in his neighborhood, charging \$.90 per car. He lays aside 20 per cent of all he earns as savings. He balances his accounts on Sundays, keeping his record from one Monday to the next. On the morning of Monday, April 17, Edward's balance was \$7.82. On Saturday, April 22, Edward washed five cars. His expenses from April 17 through April 23 were:

Monday: Lunch, \$.43; necktie, \$1.00
Tuesday: Lunch, \$.38; gum, \$.05
Wednesday: Lunch, \$.35; dues for camera club, \$.25
Thursday: Broke test tube in laboratory, \$.06; lunch, \$.40
Friday: Lunch, \$.35; film for camera, \$.65
Saturday: Hair cut, \$.90; Movies for two, \$1.20; refreshments for two, \$.60
Sunday: Church, \$.50

5. Sylvia Cameron works in a cafeteria 3 hours after school 5 days each week, and 8 hours on Saturdays. She is paid $.60 per hour, receiving her pay envelope each Tuesday. She balances her accounts every Tuesday night, keeping her record from one Wednesday to the next. She saves 25 per cent of her earnings. Sylvia's balance on Tuesday night, January 22, was $12.17. Her expenses for the week beginning Wednesday were as follows:

Wednesday:	Lunch, $.35; knitting wool, $1.25
Thursday:	Lunch, $.33; blouse, $2.99
Friday:	Lunch, $.37; school paper, $.10
Saturday:	Stockings, $1.19; earrings, $.60
Sunday:	Church, $.50
Monday:	Car pass, $1.00; lunch, $.33
Tuesday:	Lunch, $.30; pencil, $.05; theme paper, $.15

Comparing Expenses with a Standard

Standard budgets are made by averaging the expenses of a large group of people. Often the averages are expressed as per cents of the income, as they are in the standard budget for high-school students shown in Table 1. To compare your expenses with a standard, first determine what *amount* is recommended for each type of expenditure for a person with your income. Then see whether you spend more or less than this amount for this type of expenditure.

Table 1. SUGGESTED DISTRIBUTION OF HIGH-SCHOOL STUDENTS' INCOMES

Savings	25 %
Personal Needs	22 %
School Supplies	12 %
Entertainment	10 %
Gifts and Charity	10 %
Lunches	15 %
Miscellaneous	6 %
Total	100 %

Example

William Thomas has a weekly income of \$4.00. He classified his expenditures for one week as follows: savings, \$.28; personal needs, \$1.52; school supplies, \$.40; entertainment, \$.52; gifts and charity, \$.32; lunches, \$.72; miscellaneous, \$.24. Compare his expenses with the amounts recommended by the standard budget.

What to Do

(1) Multiply the income by the per cent suggested for each item.

(2) Find the difference between the amount suggested and the amount spent.

How to Do It

Item	*Standard Amount*	*Difference Between Amount Spent and Standard*
Savings	.25 × \$4.00 = \$1.00	\$1.00 − \$.28 = \$.72 less than standard
Personal needs	.22 × \$4.00 = \$ .88	\$1.52 − \$.88 = \$.64 more than standard
School supplies	.12 × \$4.00 = \$ .48	\$ .48 − \$.40 = \$.08 less than standard
Entertainment	.10 × \$4.00 = \$ .40	\$ .52 − \$.40 = \$.12 more than standard
Gifts and charity	.10 × \$4.00 = \$ .40	\$ .40 − \$.32 = \$.08 less than standard
Lunches	.15 × \$4.00 = \$ .60	\$ .72 − \$.60 = \$.12 more than standard
Miscellaneous	.06 × \$4.00 = \$ .24	\$ .24 − \$.24 = 0 or same as standard

PROBLEMS

In making the comparisons called for in these problems, express amounts of money to the nearest cent. Refer to Table 1 as necessary.

1. Ross Moore earns \$4.50 a week. One week he classified his expenditures as follows: savings, \$.45; personal needs, \$1.35; school supplies, \$.20; entertainment, \$.40; gifts and charity, \$.25; lunches, \$1.68; miscellaneous, \$.17. Compare his expenses with the amounts recommended by the standard budget.

2. Rita Federman earns \$3.50 weekly. One week she used her money as follows: savings, \$.50; personal needs, \$.64;

school supplies, \$.45; entertainment, \$.35; gifts and charity, \$.25; lunches, \$1.16; and miscellaneous, \$.15. Compare Rita's expenditures with the recommended amounts.

3. Gloria Smith receives an allowance of \$20.00 twice a month. A summary of her expenses from October 1 to October 15 follows: savings, \$2.86; shows, \$2.25; gifts, \$3.00; church, \$1.00; stockings, \$1.39; candy, \$.25; dance, \$1.00; cosmetics, \$.60; shoe repair, \$1.50; lunches, \$4.90; ice cream, \$.50; pencils, \$.25; and other items, \$.50.

a. What was Gloria's balance on October 15, assuming that she had no money at all on hand when she received her allowance on October 1?

b. Classify Gloria's expenses.

c. Compare her expenses with those recommended by the standard budget.

4. Priscilla is trying to earn enough money to buy a portable typewriter. She has two regular child-care jobs on week ends and holidays. She receives 35 cents an hour for staying with the Perry baby and 50 cents an hour when she cares for the Baxter twins. One month she worked for the Perrys for a total of 16 hours and for the Baxters for a total of 25 hours. Her expenses that month were as follows: basketball game, \$.35; church and Sunday school, \$.90; nail polish, \$.12; lipstick, \$.27; notebook paper, \$.15; milk at lunch time, 18 glasses at \$.05 a glass; refreshment drinks after school, 12 times at \$.05 and 3 times at \$.17; 2 movies at \$.44 each; 2 telephone calls at \$.05 each; birthday gift for a friend, \$1.26. She put all the rest of her money in her savings account.

a. Find Priscilla's income for the month.

b. How much money did she save?

c. Classify her expenses.

d. Compare them with the recommended amounts.

5. Wallace is saving his money for lessons in flying. He works as a delivery boy for the druggist at \$1.00 an evening, and as a handyman for Mrs. Hendricks on Saturdays at \$.50 an hour. One month he worked 12 nights for the druggist and 25 hours for Mrs. Hendricks. His expenses that month were as follows: movies for two, \$.88, three times; refreshments

for two, $.50, $.55, and $.45; church and Sunday school, $1.40; hair cut, $.90; ball game, $.99; aviation magazines, $.50; bicycle tire, $1.70. He saved all the rest of his earnings.

a. How much money did Wallace earn?

b. How much money did he save?

c. Classify his expenses.

d. Compare his expenditures with the recommended amounts.

Planning a Budget

Few persons can follow exactly the amounts suggested by a standard budget. The standard percentages can be used only as guides. The important thing is to work out a plan that fits your case. In making such a plan, take into consideration the standard budget, your record of expenses, and expenses which might not be included in a record kept for a short period of time. For example, you buy Christmas gifts only once a year; but, since Christmas gifts are likely to be a sizable item of expense, you will want to plan for them over a long period of time.

As a basis for a workable budget, one high-school boy, whose weekly earnings averaged $4.30, made the following comparison:

Item	*Standard Amount*		*Amount Spent*
Savings	.25 × $4.30 =	$1.08	$ .35
Personal Needs	.22 × $4.30 =	.95	1.83
School Supplies	.12 × $4.30 =	.52	.17
Entertainment	.10 × $4.30 =	.43	.60
Gifts and Charity	.10 × $4.30 =	.43	.20
Lunches	.15 × $4.30 =	.65	.80
Miscellaneous Items	.06 × $4.30 =	.26	.35
Totals		$4.32	$4.30

His next step was to study each item. He came to the following conclusions:

(1) The savings were smaller than they should be.

(2) Expenditures for personal needs and entertainment were too large.

Items	Standard Per Cent	Standard Amount	Amount Spent	Final Budget
Savings	25%	$1.08	$ .35	$ 1.05
Personal Needs	22	.95	1.83	1.00
School Supplies	12	.52	.17	.40
Entertainment	10	.43	.60	.45
Gifts and Charity	10	.43	.20	.40
Lunches	15	.65	.80	.75
Other Items	6	.26	.35	.25
Totals	100%	$4.32	$4.30	$4.30

Figure 4-2

(3) Expenditures for school supplies were less than the standard amount, because no books were bought during the period for which the record was kept. In his school, a student must spend about $12.00 a year for books. A yearly expenditure of $12.00 amounts to $.23 per week ($12.00 ÷ 52). Hence he should allow $.23 more per week than his record shows for school supplies.

(4) Expenditures for gifts and charity were less than the standard. The week's record did not include Christmas or birthday gifts, or contributions to the community fund or the Red Cross. These items will add about $10.00 to the yearly expenditures for gifts and charity, or $.19 per week ($10.00 ÷ 52).

(5) The amount spent on lunches was greater than the standard.

A summary of this student's planning and his final budget are shown in Figure 4–2.

PROBLEMS

In planning the budgets required in these problems, set up your work as shown in Figure 4–2.

1. Joseph Marsh receives an allowance of $2.00 a week and earns $2.25 a week by delivering newspapers. One week he had the following expenses: lunches, $.27, .27, .25, .27, .23; candy and gum, $.30; movies, $.30, .30; church, $.10; notebook, $.25; hair cut, $.75; school dance, $.60; ice cream, $.16. He placed the remaining money in a savings account. Joseph plans to spend $12.00 for gifts during the year; he has a hair cut every three weeks; he does not buy his own books, but is responsible for paper, pencils, etc. Draw up a budget for him, based on this information.

2. Robert Ward has an allowance of $2.00 a week and earns additional money doing odd jobs. During the week of January 17, which was a typical one, he earned $.50 delivering groceries and $.50 cleaning the basement. That week his expenditures were as follows: theme paper, $.15; weekly club dues, $.05; movies, $.40; hair cut, $.75; weekly school paper, $.05; school play, $.35; skating, $.25; lunches, $.75. Robert spends $8.00 a year for gifts. He pays for his hair cuts, which he gets every three weeks, but does not pay for other personal needs, such as clothing. He does not buy his books, but does pay for incidental school supplies. Plan a budget for him.

3. Marvin Drake earns $6.25 each week and gives his mother $2.00. (His net income is $4.25.) A record of his expenses one week was as follows: a dance, $1.00; school paper, $.05; candy, $.10; school lunches, $.85; class dues, $.20; bowling, $.50; and a shirt, $1.50. He estimates that he must spend $26.00 per year for clothing and $5.00 for gifts. Plan a budget for him.

4. Leslie Carson earns $5.50 per week. A record of his expenses one week was as follows: necktie, $1.25; school club dues, $.25; laboratory fee, $.25; school lunches, $.90; sodas and candy, $.40; Sunday school, $.25; football ticket, $.35; show, $.40. He estimates that each year he needs $20 for school supplies, $36 for clothing, and $15 for gifts. Plan a budget for him.

5. Barbara Hulings has a magazine agency which gives her an average profit of $26.00 in a month. One week her expenses were as follows: postage stamps, $.30; roller skating, $.55; book, $.49; school lunches, $1.15; church, $.25; earrings, $.60; ink, $.10; car pass, $1.25. Plan a budget for Barbara.

Living Within Your Budget

Once you have drawn up a budget for yourself, you should try to keep within it. Each week (or each month, if you keep your accounts on a monthly basis) you should check your expenditures with your budget. The easy way to make such a check is to keep a classified record of your expenditures. That is, enter your payments in separate columns, as in Figure 4–3. Then you can learn at a glance whether you have spent more or less than you planned to spend. Of course,

Figure 4-3

BUDGET RECORD Week Beginning May 2

Date	Explanation	Received	Paid	Savings	Personal	School	Entertainment	Gifts	Lunches
	Budget Estimate	$10.00		$3.00	$2.00	$.50	$1.00	$1.00	$2.00
May 20	Balance on hand	1 81							
	Fountain pen		74			39			35
21	Salary	10 00	3 00	3 00					
	Shoes heeled		90		50				40
	Newspaper		05						
22	Suit cleaned		1 07		69				38
23	Club dues		45			10			35
	magazine		15						
24	Date: ice cream		72				34		38
25	Movies; soda		77				60		
26	Church		25					25	
	Share of picnic		25				25		
	Totals	11 81	8 35	3 00	1 19	49	1 19	25	1 86
	Balance		3 46						
		11 81	11 81						

you do not need to explain savings and lunches. But other expenditures should be explained, as they are in Figure 4–3.

GALLOWAY

By using an envelope system of budgeting, this boy makes sure he will live within his budget.

Many people use the "envelope system" to keep within their budget. They put the money they plan to spend for items in each classification into a separate envelope. For example, since the boy who kept the record shown in Figure 4–3 had $.75 left in his gift account on May 26, he might put this amount in an envelope marked "Gifts." Then he would have it some week when he wanted to spend more than the $1.00 his budget allows for gifts.

PROBLEMS

Make out a budget record, such as the one shown in Figure 4–3, for each of the students whose financial affairs are given below.

1. Lena McCann receives $8.50 a week as a part-time clerk in a store. Her budget is as follows: savings, $2.25; personal needs, $1.75; school supplies, $.50; entertainment, $1.00; gifts and charity, $1.00; lunches, $1.50; miscellaneous, $.50. She keeps her accounts on a weekly basis, beginning with Saturdays. On Saturday, September 9, her balance was $3.48. Her expenditures for the week beginning September 9 were the following:

Saturday:	Necklace, $1.20; nail polish, $.12; dress pattern, $.50
Sunday:	Church, $.25; carfare, $.20
Monday:	Poster paper for project, $.15; lunch, $.25

Tuesday:	Lunch, $.30; stationery as gift for friend, $1.00
Wednesday:	Lunch, $.30; magazine, $.25
Thursday:	Lunch, $.25; candy, $.05
Friday:	Lunch, $.25; roller-skating, $.60; carfare, $.20

2. John Houle receives $7.25 each Tuesday for his work in a gasoline station. He wants to save $2.00 a week toward a set of golf clubs; so he budgets his expenses as follows: personal needs, $1.00; school supplies, $.50; entertainment, $1.00; gifts, $.75; lunches, $1.75; miscellaneous, $.25. John keeps his accounts on a weekly basis beginning each Monday. On Monday, March 3, he had $2.17 on hand. His expenses that week were the following:

Monday:	Library fine, $.06; lunch, $.35
Tuesday:	Lunch, $.35; toy for baby sister, $.59
Wednesday:	Shop fee, $.50; lunch, $.30; magazine, $.15
Thursday:	Lunch, $.25
Friday:	Lunch, $.30; hair cut, $.75
Saturday:	Lunch, $.40; movies, $.60
Sunday:	Church, $.25; ice cream sodas for two, $.34

3. Jim Conrad works in a bakery after school and on Saturdays. He receives $10.25 every Wednesday, of which he saves $2.75. He keeps his accounts on a weekly basis, balancing them every Sunday night. On Monday, December 2, he had $3.68 on hand. His expenditures that week were as follows:

Monday:	Lunch, $.25; candy, $.05; pencil, $.05
Tuesday:	Relief Drive, $.25; lunch, $.25; soda, $.20
Wednesday:	Shop materials, $.87; lunch, $.30
Thursday:	Lunch, $.30; tuberculosis Christmas seals, $.25
Friday:	Lunch, $.25; shoe polish, $.10; hair cut, $.75; bow tie, $1.00; school dance, self and date, $1.00
Saturday:	Movies, $.60; snack, $.30
Sunday:	Church, $.20

Jim's budget estimates for expenses are $2.00 for personal needs; $1.00 for school supplies; $1.50 for entertainment; $1.00 for gifts and charity; $1.50 for school lunches; and $.50 for miscellaneous items.

4. Mary receives $1.00 allowance each Monday, which is supposed to cover her school expenses. Since she takes sandwiches from home for lunch, she plans to spend $.50 a week in the school cafeteria and $.50 a week for other school expenses. Every school day she escorts the first- and second-grade children in her neighborhood home from school. For this service she collects $.50 each Friday from each of six mothers. She puts $1.00 of this amount in her savings account. She plans the rest of her weekly expenditures as follows: personal needs, $.75; entertainment, $.50; gifts and charity, $.50; other items, $.25. On Monday, September 10, her balance was $1.03. That week she spent money in these ways:

Monday:	Milk, $.05; notebook, $.15; pencil, $.05
Tuesday:	Milk, $.05; magazine, $.15
Wednesday:	Dessert, $.10; science club dues, $.05; lipstick, $.12; bobby pins, $.10
Thursday:	Dessert, $.10; earrings, $.30
Friday:	Milk, $.05; school party, $.25
Saturday:	Movies, $.30; ice cream soda, $.17
Sunday:	Church, $.25

5. William Gable works 3 hours after school each day and 7 hours on Saturdays. He is paid each Tuesday for his previous week's work, receiving $.60 an hour. Out of his pay he saves $3.50 a week. He budgets and keeps accounts on a weekly basis, allowing himself $1.50 each for personal needs, school expenses, and gifts and charity; $2.50 for entertainment; $2.00 for lunches; and the rest for miscellaneous expenses. On Monday, January 17, he had a balance on hand of $2.23. That week he had the following expenditures:

Monday:	Lunch, $.32; ruler, $.10; protractor, $.10
Tuesday:	Lunch, $.30; woodworking shop, $.83
Wednesday:	Lunch, $.28; birthday gift for friend, $1.20; home workshop magazine, $.25
Thursday:	School newspaper, $.10; lunch, $.23; belt, $1.50
Friday:	Lunch, $.32; screwdriver, $.39; basketball game, $.25
Saturday:	Lunch, $.45; movies for two, $1.20; refreshments for two, $.50
Sunday:	Church, $.25; carfare, $.20; soda, $.12

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"While I'm treasurer of our cottage, nobody includes cosmetics on the grocery budget."

Budgets for Young Workers

When you work at a full-time job, your earnings are greater than when you are limited to part-time jobs, but your expenses are greater, too. You are on your own, and must pay for such items as board, room, and clothing. For this reason a young worker's expenses are usually grouped somewhat differently from a high-school student's. Three classifications, however, are the same: savings, gifts and charity, and lunches. The others are board and room, clothing, and health, recreation, and education.

Every young worker has a different problem in making a budget to fit his needs. One important factor is the amount of his income. A person with an income of $200 per month surely does not need to spend twice as much for lunches as one who receives $100 per month. As your income increases a smaller percentage of it needs to be allotted for lunches and for board and room. A greater percentage of it can be saved.

Standard Budgets

Table 2 suggests what per cent should be spent for various items according to the size of the income. The income shown is the *net income*, that is, income after such items as withholding tax, social security, and amounts set aside for the payments of debts have been deducted.

Table 2. SUGGESTED DISTRIBUTION OF NET INCOMES OF $75 TO $250 PER MONTH, FOR A SINGLE PERSON

Monthly Net Income	$75	$100	$125	$150	$200	$250
Savings	8%	18%	21%	25%	28%	32%
Board and room	46%	38%	35%	32%	27%	25%
Clothing	19%	18%	18%	18%	16%	15%
Health, recreation, and education	16%	15%	15%	15%	20%	20%
Gifts and charity	3%	3%	3%	3%	4%	4%
Lunches	8%	8%	8%	7%	5%	4%

PROBLEMS

Use Table 2 in solving the following problems. The incomes are all net incomes. For the problems in which incomes are not found in the table, use the nearest net income given there. Consider 1 month equal to $4\frac{1}{3}$ weeks.

1. A young man has a net income of $100 a month. What amount of money should he save?

2. A young worker has net earnings of $200 per month. What amount of money should he save?

3. What amount can an individual afford to spend per week for board and room if his net income is $46.00 per week?

4. How much money can a young worker, whose net income is $35 per week, afford to spend each week for clothing?

5. Mary Adams takes home $23 per week.

a. What amount of money can she afford to spend for clothing and laundry each week?

b. If she plans her clothing expenditures on an annual basis, how much can she afford to spend each year for this item?

6. Richard Young has a net income of $37.50 per week.

a. How much money can he afford to spend for lunches each week?

b. If he plans his expenditures for gifts and charities on an annual basis, how much can he afford to spend each year for this item?

7. Included in the allowance for health, recreation, and education is the cost of operating an automobile. Wilbur Smith's net income is $110 per month. Can he afford to own an automobile if the cost of operating the car is $20 per month? Explain your answer.

8. Ernest Miller has a net income of $160 per month. Can he afford to live in an apartment which costs him $40 per month? Explain your answer.

9. Harold Moore wishes to go to evening school. The tuition is $20 for four months, and the cost of books is $7. His monthly income is $130 per month.

a. How much will his books and tuition cost him each month?

b. How many dollars per month does the standard budget allow for health, recreation, and education?

c. After Harold has made allowance for school expenses, how much remains for the other items in this classification?

10. Elaine Anderson begins to save for her vacation trip six months in advance. The reservation at the summer resort is $55; the railroad fare, $24.50; and she allows $30 for spending money. Elaine's monthly income is $190.

a. How much will the vacation cost her?

b. How many dollars per month does the standard budget allow for health, education, and recreation?

c. After Elaine has made allowance in her budget for her vacation trip, how much remains each month for other items in this classification?

Planning an Individual Budget

A young worker plans a budget in the same way as a high-school student does. Here is an example:

John Harris earns \$150 per month. Each month \$14.10 is deducted from his wages for income tax and \$2.25 for social security. In addition he must pay \$9.25 on a debt he owes. These amounts total \$25.60; so his net income is \$150.00 less \$25.60, or \$124.40.

John's first step was to keep a careful record of his expenses for a month, which happened to be February. His second step was to classify his expenditures and compare them with the standard amounts, found by using the per cents in the \$125 column of Table 2. He made the following comparison:

Item	*Standard Amount*	*Amount Spent*
Savings	.21 × \$124.40 = \$26.12	\$14.05
Board and room	.35 × \$124.40 = \$43.54	\$44.00
Clothing	.18 × \$124.40 = \$22.39	\$26.25
Health, recreation, and education	.15 × \$124.40 = \$18.66	\$24.50
Gifts and charity	.03 × \$124.40 = \$ 3.73	\$ 6.00
Lunches	.08 × \$124.40 = \$ 9.95	\$ 9.60

John's third step was to study his record. As he did so, he tried to consider also expenses that might be necessary in other months. He reasoned this way:

(1) My savings are far too low. I must try to add to them.

(2) I pay \$11 a week for room and board. February has only four weeks; the average month has $4\frac{1}{3}$ weeks. So I must allow more for board and room:

$$4\frac{1}{3} \times \$11.00 = \$47.67$$

Item	Standard Per Cent	Standard Amount	Amount Spent	Final Budge
Savings	21%	$26.12	$14.05	$20.8
Board and room	35%	$43.54	$44.00	$47.
Clothing	18%	$22.39	$26.25	$22.
Health, recreation and education	15%	$18.66	$24.50	$18.
Gifts and charity	3%	$3.73	$6.00	$5.5
Lunches	8%	$9.95	$9.60	$10.7

Figure 4-4

(3) The clothing expenditures are high, because I spent \$18.00 for a sport jacket. I won't need to spend this much every month. Probably \$22 per month is the correct allowance for clothing.

(4) Expenditures for health, recreation, and education are out of line because I had a dentist bill of \$8.00. That expense will not occur again for six months; so only $\frac{1}{6}$ of it need be budgeted:

$$\$24.50 - \$8.00 = \$16.50$$
$$\tfrac{1}{6} \times \$8.00 = \$1.33$$
$$\$16.50 + \$1.33 = \$17.83$$

(5) I give 50 cents a week to church:

$$4\tfrac{1}{3} \times \$.50 = \$2.17$$

My community fund gift is \$2.50 every three months:

$$\tfrac{1}{3} \times \$2.50 = \$.83$$

If I allow \$2.50 a month for other gifts, I should have enough for Christmas and birthday presents:

$$\$2.17 + \$.83 + \$2.50 = \$5.50$$

(6) I bought 24 lunches at \$.40 each. During other months I shall have to buy 26 lunches.

$$26 \times \$.40 = \$10.40$$

I cannot get my lunches any more cheaply.

As a result of this reasoning, John drew up a budget that allowed him to save more than \$20 a month. A summary of John's planning and his final budget are given in Figure 4–4.

PROBLEMS

In planning the budgets called for in these problems, set up your work as shown in Figure 4–4. Refer to Table 2 as necessary.

1. William earns \$215.00 per month, from which \$3.23 for social security and \$23.70 for income tax are deducted. He pays \$45.00 per month for board and room and \$.35 a day for lunch 26 days each month. He wishes to give \$.75 per week to the church, \$12.00 per year to the community fund and \$3.00 per year to the Red Cross.

Last year William's doctor and dentist bills and other medical expenses amounted to a little less than \$30.00, and he spent almost \$30.00 for gifts. Last month, his clothing, laundry, and cleaning expenses amounted to \$38.00.

William wants to get married as soon as he can, so he is anxious to save as much as possible. Prepare a budget for him, based on the information in this problem.

2. Arlene earns \$200 per month. Each month \$21.90 is deducted for income tax and \$3.00 for social security. Arlene pays \$50.00 per month for board and room, and \$.45 per day for lunches, 26 days each month. She expects to spend about \$200 for new clothing during the next year; she gives \$.60 per week to church, and spends \$36 per year for gifts and Christmas presents. Last month she paid a doctor bill of \$20.00, and spent \$25.00 for other items under health, education, and recreation. She does her own laundry, but finds that she spends about \$2.50 a month to have her clothes cleaned. Prepare a budget for Arlene.

3. Charles Crawford earns \$180 per month. Each month \$18.90 is withheld from his wages for income tax and \$1.80 for social security. In addition he pays \$5.00 per month on a debt. A record of expenses for a month shows that he spent his net income as follows:

Room and board	\$52.50
Clothing	28.50
Health, recreation, etc.	19.50
Gifts and charity	4.50
Lunches	12.00

Prepare a budget for him.

4. James Young earns \$300 per month. Each month \$37.70 is deducted from his wages for income tax and \$3.00 for social security. A record of his expenses for a month shows the following totals:

Board and room	\$60.00
Clothing	40.00
Health, recreation, etc.	55.00
Gifts and charity	10.00
Lunches	17.50

Prepare a budget for him.

5. Mary earns \$125 per month. Each month \$10.50 is deducted for withholding tax and \$1.25 for social security. In addition she pays \$5.00 each month on a debt. Her fixed expenses are as follows:

\$40.00 per month for board and room
\$.40 per day for lunch, 26 days each month
\$180 a year for new clothing
\$30 a year for night school and books
\$25 per year for doctor and dentist bills
\$.50 a week to the church
\$5.00 a year to the community fund
\$1.00 a year to the Red Cross

Prepare a budget for her.

"I make enough to buy you the little luxuries, dear. It's the rent and grocery bills that bother me!"

Family Budgets

When a young worker marries, he or she takes on additional responsibilities. One of these responsibilities — shared by the husband and the wife — is the wise management of the family income. Wise money management requires planning; that is, budgeting.

Family budgets are made in the same way as individual budgets, but they are likely to be more complicated, since at least two people are involved. Expenditures are usually

grouped under these headings: savings; food; shelter; operating expenses; clothing; and advancement. Items included under the various headings are described below.

Savings: bank deposits; investments in credit unions, savings and loan societies, and the like; bond purchases (see Chapter 8); life insurance premiums (see Chapter 9); retirement payments; payments on the principal in buying a home (see Chapter 11)

Food: cost of meals purchased away from home; cost of food for preparation at home

Shelter: rent; interest payments on a home loan or mortgage; fire insurance premiums; real estate taxes; cost of repairs, improvements, and upkeep (see Chapter 11)

Clothing: new clothing, cleaning and laundry bills, etc.

Operating: cost of fuel; bills for utilities (see Chapter 6); cost of household supplies (see Chapter 5)

Advancement: money spent for health, education, and recreation; gifts and charity; allowances to family members for personal needs; cost of transportation (see Chapter 12)

In the family pictured here, all the members take part in preparing the budget, and all co-operate in the effort to live according to the plan.

Standard Budgets for Families

Of course, families vary in size, in standard of living, and in special needs and desires. For this reason it is impossible to make a standard budget that will suit all families. Table 3 gives suggested budgets for families of various sizes.

Table 3. SUGGESTED DISTRIBUTION OF NET INCOMES OF $200 TO $400 PER MONTH, FOR FAMILIES OF TWO TO FIVE MEMBERS

Monthly Net Income	**$200**	**$250**	**$300**	**$350**	**$400**
Family of Two					
Savings	$35	$53	$74	$105	$140
Food	60	65	75	75	80
Shelter	45	50	55	60	70
Operating	15	20	25	30	30
Clothing	18	22	26	30	30
Advancement	27	40	45	50	50
Family of Three					
Savings	$30	$46	$65	$88	$120
Food	65	70	80	85	90
Shelter	45	50	55	65	75
Operating	15	20	25	30	30
Clothing	19	24	30	32	35
Advancement	26	40	45	50	50
Family of Four					
Savings	$20	$37	$57	$77	$105
Food	75	80	90	95	105
Shelter	45	50	55	65	75
Operating	15	20	25	30	30
Clothing	20	26	30	33	35
Advancement	25	37	43	50	50
Family of Five					
Savings	$10	$25	$ 43	$ 64	$ 90
Food	85	90	100	105	110
Shelter	45	50	55	65	75
Operating	15	20	25	30	35
Clothing	21	28	34	36	40
Advancement	24	37	43	50	50

PROBLEMS

Use the information in Table 3 to find the answers to the questions that follow. The incomes given in the problems are all net incomes.

1. If the monthly net income of a family of two increases from \$200 to \$250, how much is the increase in the amount suggested for each of the following?

a. food	**d.** clothing
b. shelter	**e.** advancement
c. operating	**f.** savings

2. If the monthly net income of a family of four increases from \$200 to \$250, how much is the increase in the amount suggested for each of the following?

a. food	**d.** clothing
b. shelter	**e.** advancement
c. operating	**f.** savings

3. It is generally agreed that a family should not spend more than 20 per cent of the monthly income for rent. What per cent of the income is allowed for rent in each of the following cases?

a. A family of two with a monthly income of \$250
b. A family of three with a monthly income of \$300
c. A family of four with a monthly income of \$400
d. A family of five with a monthly income of \$400

4. Budget authorities say that it is not advisable to spend more than 30 per cent of the monthly income for food. What per cent of the income is allowed for food in each of the following cases?

a. A family of two with a monthly income of \$300
b. A family of three with a monthly income of \$350
c. A family of four with a monthly income of \$400
d. A family of five with a monthly income of \$200

5. Walter Smith has a wife and two children. His salary is \$250 a month. Can Mr. Smith afford to own an automobile if the monthly cost of running it is \$25? Explain your answer.

6. Mr. and Mrs. Gregg have three children. Their net income is $300 a month. Can they afford an automobile if it costs them $33 a month to run it? Explain your answer.

7. Make a table showing how the suggested distribution of a monthly net income of $300 changes as the size of a family increases. Use this form:

SUGGESTED DISTRIBUTION OF A MONTHLY NET INCOME OF $300, FOR FAMILIES OF TWO TO FIVE MEMBERS				
Number in Family	**2**	**3**	**4**	**5**
Savings				
Food				
Shelter				
Operating				
Clothing				
Advancement				

8. Make a table showing how the distribution of a monthly net income of $350 changes as the size of a family increases. Use this form:

SUGGESTED DISTRIBUTION OF A MONTHLY NET INCOME OF $350, FOR FAMILIES OF TWO TO FIVE MEMBERS				
Number in Family	**2**	**3**	**4**	**5**
Savings				
Food				
Shelter				
Operating				
Clothing				
Advancement				

9. How much do the expenditures for advancement increase for a family of three when the monthly income increases:

a. From $200 to $250
b. From $250 to $300
c. From $300 to $350
d. From $350 to $400

10. How much do the savings for a family of four increase as the income increases:

a. From $200 to $250
b. From $250 to $300
c. From $300 to $350
d. From $350 to $400

Preparing a Budget for a Family

The steps in planning a family budget are the same as those in planning a budget for a student or for a young worker: (1) keeping a record of actual income and expenditures; (2) classifying the expenditures and comparing them with those recommended in a standard budget; (3) studying the comparison and working out a budget that fits the family needs.

PROBLEMS

In solving these problems, refer to Table 3 as necessary.

1. The Elliott family consists of Mr. and Mrs. Elliott and Barbara, age 15. Mr. Elliott's net salary is $285 a month. A record of their monthly expenses and savings is given below.

Rent	$42.50	Recreation	$ 5.00
Clothing	22.00	Carfare	3.00
Electricity	3.00	Personal allowances	10.25
Gas for cooking	3.00	Barber, beauty parlor, etc.	5.00
Telephone	4.25	Auto repairs	7.00
Household supplies	4.00	Gas and oil for car	12.00
Food and milk at home	60.00	Benevolence	4.00
Mr. Elliott's lunches	12.00	Savings account	35.00
Barbara's lunches	6.00	Retirement fund	14.50
Newspapers	1.80	Emergencies	2.00
Doctor and dentist	5.00		

In addition to the expenses listed above, every month the Elliotts put aside an amount equal to $\frac{1}{12}$ of each of the following annual expenses:

Coal bill, $86.40
Club dues, $24.00
Life insurance, $96.00.

The balance of Mr. Elliott's monthly salary is placed in a fund to be used later to purchase a new washing machine for Mrs. Elliott.

a. How much is placed in the washing-machine fund?

b. Compare the Elliotts' expenditures with the standard amounts by making out a form such as this:

Item	*Standard Amount*	*Amount Spent*	*Difference between Amount Spent and Standard*

2. Mr. and Mrs. Arnold have two children. Mr. Arnold's salary, after deductions, is $300 per month. During the month of November, Mrs. Arnold kept the following record of expenditures:

Rent for the month	$65.00
Milk bill	12.30
Fruit and vegetables	25.90
Groceries	37.40
Meat	22.40
Meals at restaurant	8.45
Coal bill	11.75
Light bill	5.30
Telephone	3.35
Children's allowance	8.00
Mr. Arnold's allowance	6.00
United States Savings Bond	18.75
Pair of shoes for Mr. Arnold	7.89
Given to church	$4.00
Carfare for Mr. Arnold	5.00
Dentist bill	6.00
Newspapers and magazines	2.30
Toilet supplies	1.75
Hair cut for Mr. Arnold	1.00
Gas and oil for car	14.75
Dress for Mrs. Arnold	13.95
Shoe repair	2.85
Deposited in savings account	8.41

Classify the Arnolds' expenditures and compare them with the standard amounts.

3. In the Holmes family are Mr. and Mrs. Holmes and Alan, aged three. Mr. Holmes' salary after deductions is $250 per month. Last month Mrs. Holmes kept a classified record of the family expenditures. She found that they had saved

$12.00 and had spent $78.50 for food, $67.50 for shelter, $27.50 for clothing, $22.00 for operating expenses, and $42.50 for advancement, of which $17.50 was for operating the family car. Mr. and Mrs. Holmes feel that their savings are too low and their shelter costs too high. However, they cannot find a less expensive place to live; so they will have to continue paying $67.50 a month rent. Compare the Holmes' expenditures with the standard amounts, and draw up a budget for them, including as much savings as you believe advisable. Use a form such as this:

Item	*Standard Amount*	*Amount Spent*	*Budget*

4. The Craigs, who have two children, have a net income of $300 a month. Their expenses for a month were as follows:

Food	$108.35	Automobile	$15.07
Shelter	65.00	Personal allowances	16.00
Operating	23.20	Newspapers and magazines	2.65
Clothing	27.63	Recreation	7.50
Medical care	8.00	Beauty shop and barber	3.85
Savings	18.75		
Charity	4.00		

Compare their expenditures with those suggested in the standard budget, and prepare a budget for them.

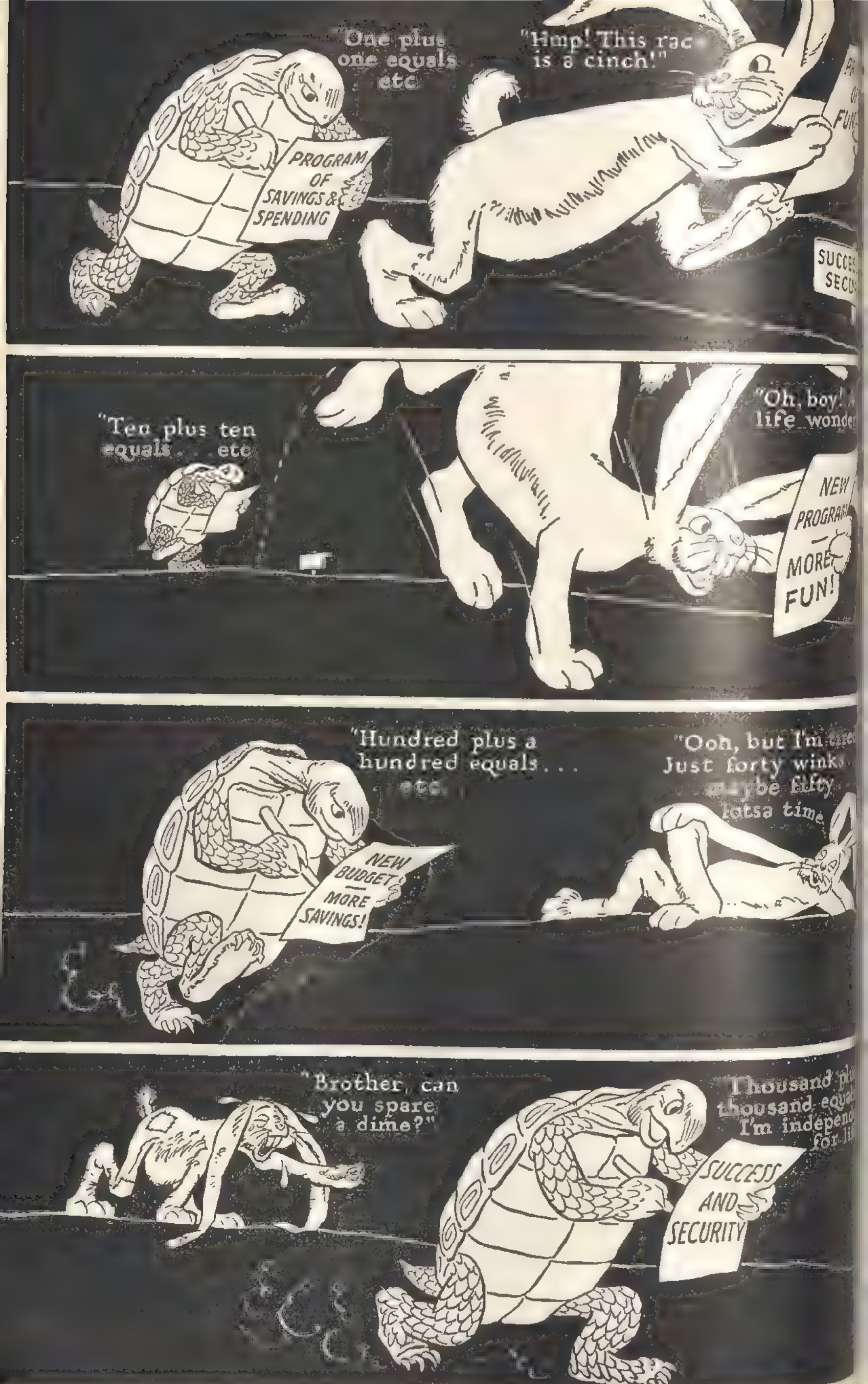
5. Mr. and Mrs. Charles have a monthly take-home income of $287.50. Their average monthly expenditures last year were: rent, $52.50; food and milk, $65.00; clothing, $27.50; gas for cooking and heating, $8.00; husband's carfare, $6.50; husband's allowance, $10.00; doctor and dentist bills, $5.00; recreation, $5.00; beauty parlor and barber, $4.00; newspaper and magazines, $3.25; telephone, $3.88; electricity, $3.50; life insurance, $7.30; wife's allowance, $10.00; benevolence, $5.00; gasoline and oil for car, $13.00; repair on car, $7.00; incidentals, $7.50; household supplies, $5.00; car payment, $37.50.

Deduct the car payment from the monthly income and make a budget for the balance of the income.

What You Have Learned in This Chapter

1. The three steps to take in making any budget:
   Keep a record of income and expenditures
   Classify the expenditures and compare them with the amounts in a standard budget
   With the standard budget and individual needs as guides, decide how the income should be used
2. The form to follow in keeping a simple cash record
3. The form to follow in keeping a classified record of income and expenditures
4. The classifications used for expenses of high-school students, young workers, and families
5. To prepare budgets, using tables showing suggested distribution of expenditures for various income levels

By budgeting, a family finds it possible to have money for luxuries, such as a television set.


"One plus one equals etc.
PROGRAM OF SAVINGS & SPENDING
"Hmp! This rac is a cinch!"
"Ten plus ten equals ... etc.
"Oh, boy!
life wonde
NEW PROGRAM MORE FUN!
"Hundred plus a hundred equals ...
NEW BUDGET MORE SAVINGS!
"Ooh, but I'm
Just forty wink
lotsa time
"Brother, can you spare a dime?"
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SUCCESS AND SECURITY

Review Test on Budgets

1. James Workman, a high-school student, has a part-time job which pays him $9.25 every Tuesday. He puts aside $2.25 of his pay as savings. On Monday, November 18, James had a balance on hand of $2.82. That week he had the following expenses:

Monday:	Lunch, $.27; drawing paper, $.15; hard pencil, $.05
Tuesday:	Radio Club dues, $.10; lunch, $.27; shoes heeled, $.60
Wednesday:	Library fine, $.09; lunch, $.23; notebook paper, $.10; contribution for Thanksgiving baskets, $.25
Thursday:	Lunch, $.30; hair cut, $.90; magazine, $.15
Friday:	Lunch, $.27; after-school dance for two, $.25
Saturday:	Hot dogs at football game, $.15; movie date, $1.20; hot chocolate for two, $.22
Sunday:	Church, $.25; carfare, $.20

Prepare a simple cash record of James's income and expenditures for the week of November 18.

2. A standard budget for high-school students suggests that 25 per cent of the income be saved; 22 per cent used for personal needs; 12 per cent used for school supplies; 10 per cent spent for entertainment; 10 per cent allotted to gifts and charity; 15 per cent used as lunch money; and 6 per cent used for miscellaneous purposes. Thomas Williams has a weekly income of $6.25. He classified his expenditures for one week as follows: savings, $.50; personal needs, $1.40; school supplies, $.15; entertainment, $1.82; gifts, $.10; lunches, $1.75; miscellaneous, $.53. Compare Thomas's expenses with the amounts recommended by the standard budget.

3. Ruth Engle is a high-school student who has a part-time job. She receives $7.50 for her work each Friday. She keeps her accounts on a weekly basis, beginning each Sunday. Ruth tries to live within the following budget: savings, $2.00 a week; personal needs, $1.25; school supplies, $.50; entertainment, $1.00; gifts and charity, $1.00; lunches, $1.25; miscellaneous

expenses, $.50. On Sunday, October 16, she had a balance on hand of $4.25. Her expenditures for the week were as follows:

Sunday:	Church, $.25
Monday:	Lunch, $.25; art club dues, $.10
Tuesday:	Lunch, $.25; movies, $.30
Wednesday:	Lunch, $.25; fountain pen, $.39
Thursday:	Lunch, $.25; basketball game, $.30; "pop," $.05
Friday:	Lunch, $.25; roller skating, $.30
Saturday:	Kit for hair waving, $1.20; toy for little brother, $.49; magazine, $.25

a. Prepare a classified budget record of Ruth's income and expenses for the week.

b. Judging from her expenses, do you consider Ruth's budget a good one? Explain your answer.

4. Perry Blanchard is a young worker who receives take-home pay of $134.40 each month. Last month he kept a record of all his expenditures. When he classified them, he found he had spent these amounts:

Board and room	$45.00
Clothing	33.78
Health, recreation, and education . .	27.10
Gifts and charity	5.00
Lunches	18.20

He put what remained in his savings account, but was dissatisfied with the amount. Upon consulting a standard budget, he learned that the recommended distribution of an income such as his was as follows: savings, 21%; board and room, 35%; clothing, 18%; health, recreation, and education, 15%; gifts and charity, 3%; lunches, 8%. Perry does not believe that he can cut down on the amount he spends for board and room or on the amount he spends on gifts and charity. He must buy 26 lunches a month.

a. Compare Perry's expenditures with the standard amounts.

b. Prepare a budget for him that will allow greater savings.

5. The Tyler family, consisting of Mr. and Mrs. Tyler and their two children, has an income of $250 per month after all deductions have been made. The Tylers are finding it hard to make ends meet; so last month Mrs. Tyler kept a careful record of their expenses, and classified them as follows:

Food	$102.56
Shelter	50.00
Operating expenses	20.48
Clothing	37.52
Medical care	5.80
Recreation	7.35
Operating the automobile	14.27
Barber and beauty shop	5.00
Church and charity	4.00
Newspapers	2.50
Allowances	5.00

When the Tylers consulted a suggested budget for a family of four with a net monthly income of $250, they found these recommended expenditures: savings, $37; food, $80; shelter, $50; operating, $20; clothing, $26; advancement, $37.

a. Compare the Tylers' expenses with the recommended amounts.

b. Prepare a budget for the Tylers that will enable them to save something each month.

How do you rate?	Excellent	Good	Fair	Poor
	5	4	3	2 or less

CHAPTER

5

LAMBERT

1. Draw up a list of articles used in your home that might well be bought in larger quantities than will be needed at one time.
2. Make comparisons of the costs of some products that are sold in packages of different sizes. For example, make a display chart showing comparative prices, using labels taken from canned goods.
3. Do some "comparison shopping" and report on savings currently possible by taking advantage of sales.
4. Get some consumer bulletins and find how goods are compared for quality.
5. Get a mail-order catalog and make out orders for articles you would like to have.
6. Find advertisements for articles sold on the installment plan, and figure the amounts and rates of interest charged.

SPENDING WISELY

An old proverb says, "A penny saved is a penny earned." If you are able to save even a few cents on each purchase, your total savings in a month or a year will be a considerable amount. It is good business to know how to save money while spending it!

Stretching the Dollar

Often you can save money by buying in large quantities or at sale prices. You can stretch your dollars if you are able to judge the quality of the articles you buy in relation to the price. Frequently you can save by paying cash instead of charging your purchases, and many times you can get a discount on your bills by paying them promptly.

Buying in Quantity

Have you ever seen a housewife buy a single can of soup when the soup was priced at 2 cans for 23 cents? Usually she buys two cans at a time, even though the saving is only a half cent a can, for she knows that she will use them both. If foods can be kept without spoiling, it is often wise to buy them in larger quantities than are needed immediately.

Example

Mrs. Farris generally buys grapefruit juice one or two cans at a time, paying \$.29 a can. She learns that she can buy a dozen cans for \$2.82. How much can she save by buying a dozen cans at a time?

What to Do	How to Do It
(1) Find the cost of one dozen cans when bought one at a time.	$12 \times \$.29 = \$3.48$
(2) Find the difference between this amount and the cost per dozen.	$\$3.48 - \$2.82 = \$.66$ Answer

PROBLEMS

1. How much is saved if 12 cans of blended juice are bought at \$2.85 per dozen instead of at \$.31 each?

2. Mr. and Mrs. Hart rent a deep-freeze locker. One year they stored 95 pounds of meat. The rental of the locker, the cost of meat, and the cost of having the meat prepared for the freezer, totaled \$40.85. They estimated that the meat could have been purchased at the market at an average price of 61 cents per pound. How much did the Harts save on meat that year?

3. Mrs. Walters finds that apples are priced in the grocery store at 2 pounds for \$.25. How much can she save on a bushel of 56 pounds if she buys at the market where the price is \$4.00 per bushel?

4. How much is saved if 12 cans of orange juice are bought at \$2.88 per dozen instead of at 2 cans for \$.51?

5. Mrs. Hoyt uses 120 pounds of sugar in a year. She can buy two-pound boxes at \$.23 a box or ten-pound bags at \$1.03 a bag. How much can she save in a year by buying sugar in ten-pound bags rather than in two-pound boxes?

6. The Anderson family of four consumes 400 pounds of potatoes in a year. How much can Mrs. Anderson save in a year if she buys the potatoes in 100-pound bags at \$4.50 instead of in 10-pound bags for \$.59?

7. At the service station, Mr. Page was paying \$.38 per quart for oil. He decided to buy a five-gallon can of oil and put oil in the car himself when needed. The five-gallon can of oil cost \$6.15. How much did Mr. Page save on 20 quarts of oil (1 gallon = 4 quarts)?

8. The cost of stock spray is \$.90 per gallon or \$3.99 for a five-gallon can. How much cheaper is it to order 5 gallons in a five-gallon can than in one-gallon cans?

9. In ordering chicks from a poultry farm, Mr. Rolland finds that the price for 25 chicks is \$4.27 and for 100 chicks is \$15.75. If he takes advantage of the rate for 100 chicks, how much less does he pay than if he buys 100 chicks 25 at a time?

10. Mr. Cummings wishes to buy 200 poults (young turkeys). He can buy them from one poultry dealer at \$29.25 for 25 and from another dealer at \$114.50 per 100. How much better is the second offer?

Comparing Prices

Many products are sold in packages of different sizes at different prices. To buy wisely, you must understand the relations among such units as ounces and pounds, pecks and pints, and quarts and gallons.

Units of weight. You undoubtedly know the commonly used units of weight: *ounces*, *pounds*, and *tons*.

16 ounces (oz.) = 1 pound (lb.)
2000 pounds = 1 ton (T.)

Dry measure. Perhaps you have bought a *pint* of raspberries, a *quart* of Brussels sprouts, a *peck* of potatoes, or a *bushel* of apples.

2 pints (pt.) = 1 quart (qt.)
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)

Dry-measure units are units of *capacity*. They do not indicate weight. For example, a bushel of corn weighs considerably more than a bushel of oats. Some common weights are:

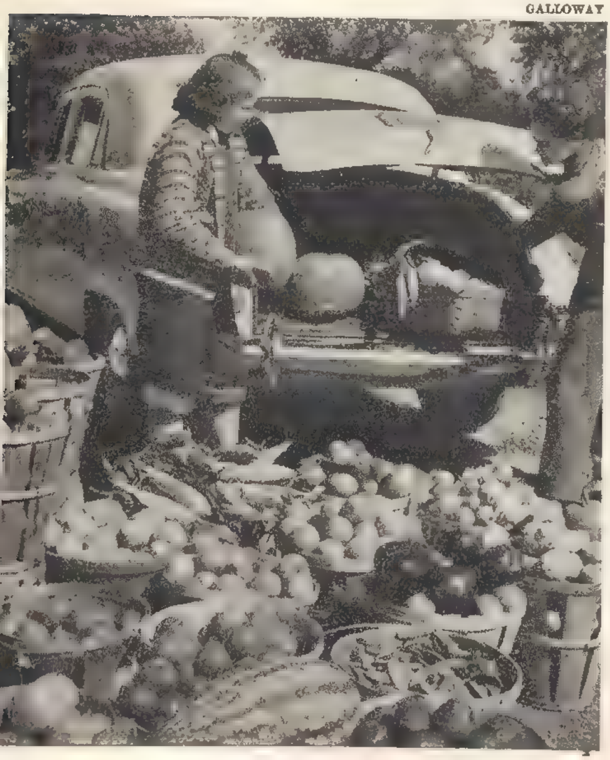
1 bu. oats	= 32 lb.
1 bu. rye	= 56 lb.
1 bu. apples	= 56 lb.
1 bu. peaches	= 56 lb.
1 bu. shelled corn	= 56 lb.
1 bu. potatoes	= 60 lb.
1 bu. wheat	= 60 lb.
1 bu. corn on the cob	= 70 lb.

Liquid measure. When you buy vanilla by the *fluid ounce*, cream by the *pint*, milk by the *quart*, and gasoline by the *gallon*, you are dealing in liquid measure.

16 fluid ounces (oz.)	= 1 pint (pt.)
2 pints	= 1 quart (qt.)
4 quarts	= 1 gallon (gal.)

Savings are often possible if you can arrange to buy from the producer.

GALLOWAY



Liquid-measure units, like dry-measure units, are units of capacity; they are not units of weight. A fluid ounce of water happens to weigh about an ounce, but a fluid ounce of turpentine weighs less than an ounce. A pint of water weighs just about a pound, but a pint of pea soup weighs more than a pound.

Can sizes. Fruits and vegetables are often sold in cans. The size of each can is expressed as a number. Can sizes are measures of capacity.

Therefore they can be described in terms of fluid ounces, as follows:

No. 1 can = $10\frac{1}{2}$ fluid oz.
No. 2 can = 20 fluid oz.
No. $2\frac{1}{2}$ can = 30 fluid oz.
No. 5 can = 43 fluid oz.
No. 10 can = 128 fluid oz. (1 gal.)

The weight of a can of food depends on the kind of food it contains. Read the label on a can to find out how much its contents weigh.

When you are buying something that is sold in packages of different sizes at different prices, you can compare the prices by finding the cost per unit of weight or capacity.

Example Which is the better buy, a hundred-pound bag of potatoes at \$4.49 or a bushel of equally good potatoes at \$2.99?

What to Do	How to Do It
(1) Express the quantities in the same kind of unit.	1 bag of potatoes = 100 lb. 1 bu. of potatoes = 60 lb.
(2) Find the cost per unit of each quantity to the nearest tenth of a cent.	\$4.49 ÷ 100 = \$.0449 = \$.045 \$2.99 ÷ 60 = \$.0498 = \$.050
(3) Select the less expensive.	The bag is less expensive. Answer

PROBLEMS

Refer to the facts about units of weight and capacity as you solve these problems. Show all your calculations.

1. Which is cheaper, a twenty-ounce package of pancake flour at \$.13 or a pound package at \$.11?

2. Which is the better bargain, a No. $2\frac{1}{2}$ can of peaches for \$.33 or a No. 2 can for \$.24?

3. Which is cheaper, four No. $2\frac{1}{2}$ cans of beets at $.12 each or six No. 2 cans at 2 for $.25?

4. Which is the better buy, six No. 2 cans of peas at 2 for $.19 or four No. $2\frac{1}{2}$ cans at $.11 each?

5. Mrs. Fine can buy potatoes at 10 pounds for $.59 or at $3.10 per bushel. Which is more economical?

6. Mrs. Carlson can buy apples at 2 pounds for $.25 or at $1.00 per peck. Which is the less expensive way to buy?

7. How much is saved by buying 2 quarts of prune juice at $.29 per quart rather than at $.16 per pint?

8. How much is saved by buying a half pound of tea for $.31 instead of buying the same amount in four-ounce packages at $.20 each?

9. Tomato juice is sold in 46-ounce cans for $.27. Two No. 2 cans are sold for $.27. Which is the lower price?

10. One No. 5 can of sliced peaches cost $.35. Two No. 2 cans also cost $.35. Which is the better buy?

Buying at Sale Prices

When a new model radio is put on the market, last year's model may be offered at a reduced price. When goods move slowly, storekeepers will often advertise sales to encourage

Everyone is familiar with newspaper advertisements of sales. Often you can save money by taking advantage of price reductions.

people to buy. You should be able to figure what per cent of the regular price you save by paying the sale price.

Example

Mrs. Barnes generally pays $1.50 for 12 cans of evaporated milk. The sale price of 12 cans is $1.29. What per cent of the regular cost can she save by taking advantage of this sale?

What to Do	How to Do It
(1) Subtract the sale price from the regular price to find the amount saved.	$1.50 − $1.29 = $.21
(2) Divide the difference by the regular price to find what per cent was saved.	.21 ÷ 1.5 = .14 .14 = 14% **Answer**

PROBLEMS

1. A gallon of cleaner which generally costs $4.50 was sold at a special sale price of $2.98. What per cent of the regular price can be saved by buying at the sale price?

2. A garden plow regularly priced at $6.49 is offered at a sale price of $4.98. What per cent of the regular price can be saved by buying at the sale price?

3. One Saturday morning Mrs. Panek studied the shopping advertisements and found she could save on the food she needed that day as follows:

Article	*Regular Price*	*Sale Price*	*Quantity Purchased*
No. 2 can, apple sauce	$.19	$.15	3 cans
No. $2\frac{1}{2}$ can, peach halves	.29	2 cans for .53	2 cans
Boiled ham	1.24 per lb.	.96 per lb.	$\frac{1}{4}$ lb.
Pork shoulder roast	.69 per lb.	.59 per lb.	3 lb.

a. How much money did Mrs. Panek save?

b. What per cent of the total cost at regular prices did she save?

4. One morning Mrs. Gibson bought the following food that was on sale:

Article	*Regular Price*	*Sale Price*	*Quantity Purchased*
Beef liver	$.69 per lb.	$.65 per lb.	1 lb.
Shortening	.45 per lb.	3 lb. for $1.17	3 lb.
No. $2\frac{1}{2}$ can, apricots	.33 per can	.25 per can	4 cans
46 oz. can, tomato cocktail	.28 per can	2 cans for $ 19	2 cans

a. Find the amount of her savings.

b. What per cent of the total cost at regular prices did she save?

5. The regular price of a claw hammer is $1.25 and of a sheep wool sponge is $1.39. At a sale Mr. Cameron was able to buy the hammer for $.79 and the sponge for $.89. What per cent of the total cost at regular prices did he save?

6. A pair of slippers which regularly sold for $4.45 were advertised for $2.95, and a boy's sweater was reduced from $2.98 to $1.67. If Mrs. Mills bought these articles, what per cent of their total cost at regular prices did she save?

7. At a dollar sale, Mrs. Young bought some clothing needed for her family, as follows:

Article	*Regular Price*	*Sale Price*
1 pair of tennis shoes	$1.95	$1.00
1 pair of children's shoes	1.95	1.00
2 sunsuits	1.00 each	2 for $1.00
1 Tee shirt	1.65	1.00

a. How much did she save?

b. What per cent of the total cost at regular prices did she save?

8. Mrs. Smith bought the following articles at special sales:

Article	*Regular Price*	*Sale Price*
Garden hose reel	$7.50	$6.95
Electric iron	8.25	7.15
Mattress	19.80	17.88
Shower curtain	6.96	4.95

a. How much were her total savings?

b. What per cent of the total cost at regular prices did she save?

9. During the month of August, Mrs. Meyers found that she had saved in buying the following articles at special sales:

Article	*Regular Price*	*Sale Price*
4 81″ × 108″ muslin sheets	$3.15 each	$2.99 each
4 yards tissue gingham	2.85 per yd.	2.50 per yd.
1 gallon thermos jug	2.95	2.19
1 innerspring mattress	30.00	24.75

a. Find her total savings.

b. What per cent of the total cost at regular prices did she save?

10. During the year Mr. Rice made three important purchases on which he saved money by using sale prices. He bought a cream separator for $121.25, regularly priced at $140; a sweep rake for $87.75, regularly priced at $98.00; and a loader for $184.50, regularly priced at $220.00.

a. Find his total savings.

b. What per cent of the total cost at regular prices did he save?

Comparing Goods for Quality

Price is not the only thing to consider in making purchases. Quality is important, too, and should be considered in relation to the use you intend to give the goods you buy. For example, if you were planning to drive an old car only six months longer and its battery wore out, you would not be particularly interested in a battery guaranteed to last two years, even though it was only slightly more expensive than one guaranteed to last one year. On the other hand, if you intended to drive the car for several years before you bought a new one, the better

In announcing sales, many stores point out the possible savings in terms of per cents.

INTERNATIONAL

BUREAU OF HOME ECONOMICS

The young woman is testing the color fastness of fabrics when they are exposed to light. She works in a laboratory of the United States Department of Agriculture.

battery would probably be the better buy.

Operating costs must be taken into consideration, also. One refrigerator might be much cheaper to buy than another, but much more expensive to run. Over a period of years, you may actually lose by buying the lower priced article.

Fortunately, you can get information about the quality of goods. Several consumers' organizations and the Department of Agriculture have testing laboratories whose reports are published. Some stores are able to supply information such as the number of threads to the inch in fabrics. Labels tell what fibers a garment is made of.

PROBLEMS

1. Mrs. Anderson studied consumer reports about blankets before buying. She learned that a certain blanket costing $10.50 would probably last five years and that another kind costing $19.75 could be expected to last fifteen years.

a. What would be the cost per year of the blanket priced at $10.50?

b. What would be the cost per year of the blanket priced at $19.75?

2. A consumer bulletin stated that a certain automobile battery priced at $13.19 would give ordinary service for a year and a half and that another battery priced at $11.50 would probably last a year at most.

a. What is the cost per month of the $11.50 battery?

b. What is the cost per month of the battery priced at $13.19?

3. Mr. Barnes has a razor which cost him \$2.50. Blades and other shaving materials cost him \$.90 per month. Mr. Harris has an electric razor which cost \$18.75. He estimates the cost of upkeep at \$.50 per year. Compare the costs of the two razors over a period of five years.

4. Mr. Smith studied a number of consumer bulletins before he purchased a refrigerator. The price of one refrigerator was \$229.95, and the estimated cost of operation was \$1.08 per month. Another refrigerator was priced at \$224.85, and the cost of operation was estimated at \$1.50 per month. How much did Mr. Smith save in eight years if he bought the first refrigerator?

5. Boneless veal cost \$.59 per pound. Mrs. May used $\frac{3}{4}$ of a pound in serving a meal of veal stew for her family of four. Four rib chops of veal, weighing a total of $1\frac{1}{4}$ pounds, would have supplied the same amount of meat at the cost of \$.79 per pound. How much cheaper was the veal stew than the rib chops?

6. Mrs. Brown wishes to serve $\frac{1}{4}$ pound of liver to each member of her family of five. How much does she save in buying beef liver at \$.60 per pound rather than calves' liver at \$.95 per pound?

7. Garden hose priced at \$2.49 per 25 feet is guaranteed for five years. Hose of the same diameter priced at \$3.49 per 25 feet is guaranteed for ten years. What is the cost per year of 25 feet of each kind of hose?

8. A radio storage battery costing \$8.50 is guaranteed for two years. A similar battery costing \$14.50 is guaranteed for three years. What is the cost per year of each battery?

9. A report of the United States Department of Agriculture states that a fattened roasting chicken has 63 per cent edible meat and an unfattened roasting chicken has 57 per cent edible meat. The price of a fattened chicken is \$.55 per pound; the unfattened chicken is \$.52 per pound.

a. What is the cost per pound of edible meat on a fattened chicken?

b. What is the cost per pound of edible meat on an unfattened chicken?

GALLOWAY

In some stores, sales clerks can give buyers information about the quality of the goods they sell, such as the number of threads in a square inch.

10. A recent experiment showed that a ham cooked at a constant temperature of 450 degrees lost 30 per cent of its weight by shrinkage while a ham cooked at a constant temperature of 250 degrees lost 13 per cent of its weight. Uncooked ham costs $.65 per pound.

a. What is the cost per pound of ham cooked at a constant temperature of 450 degrees?

b. What is the cost per pound of ham cooked at a constant temperature of 250 degrees?

Buying for Cash

Some stores sell only for cash or for cash on delivery (C.O.D.). Prices may be lower in "cash-and-carry" stores than in stores that handle charge accounts, because expenses are lower.

Some stores encourage their customers to pay cash for their purchases by offering discounts. Others issue trading stamps. Usually they give one stamp for each $.10 worth of goods purchased. When the customer has accumulated 1200 stamps, he may redeem them for $3.00 worth of merchandise.

PROBLEMS

1. Mr. Whitney found that the paint for his house would cost $32.00 at a certain store that permits charge accounts, and 5 per cent less at a cash-and-carry hardware store. How much did he save by buying at the less expensive rate?

2. The store in which Mrs. Hutchinson buys her groceries delivers the orders to her home. Her bill averages $65.50 per month at this store. How much more does she pay each month than she would have to pay at a cash-and-carry which is able to sell 2 per cent cheaper?

3. A large department store estimates that the cost of maintaining charge accounts is 1.5 per cent of the selling price

of the goods it sells. If Mrs. Martin spends an average of $40.00 per month at this store, how much does her charge account cost her in a year?

4. A grocery store must add 2.5 per cent of the selling price to cover the cost of delivery. Mrs. Kline buys $65 worth of groceries at this store each month. How much does the delivery charge cost her each month?

5. If a trading stamp has a value of $.0025 and is given for each $.10 purchase, what per cent of the purchase price is returned in trading stamps?

6. One gasoline station sells gasoline at $.25 per gallon and gives one trading stamp worth $.0025 with each gallon of gasoline. The station on the opposite corner charges only $.245 per gallon for the same quality gasoline, but does not give trading stamps. If you wished to trade regularly at one of the two stations, which one would you choose?

7. Mr. Morse bought a desk for $66.80. The store allowed him a 10 per cent discount for paying cash.

a. How much discount was allowed?

b. What was the net amount he paid for the desk if he paid cash?

8. Mr. Kerr bought an electric hot water heater for $122.50. The dealer told him that a 5 per cent discount was allowed for cash payment.

a. Find the amount of the discount.

b. Find the cash cost.

9. The following articles were bought at an 8 per cent cash discount:

Lamp	$4.48
Curtains	3.50
Laundry hamper	8.85
Bath mat	5.75

How much did the purchaser pay?

10. Find how much Mr. Packard saved by buying the following articles at a store that offers a 5 per cent discount for cash:

1 tool box	$ 6.95
1 socket set	11.95
1 combination square	6.95
1 ball-bearing bit brace	3.49
1 hand drill	2.50

Paying Bills Promptly

There are at least two advantages to be gained by paying your bills promptly. One is that you save money. The other is that you obtain a good *credit rating*. In small towns, storekeepers know their customers and the extent to which each can be trusted. In cities, business men usually belong to a retail credit association. This association rates the citizens according to the promptness with which they pay their bills. A good credit rating enables a person to open charge accounts, buy equipment on the installment plan, borrow money to meet emergencies, and the like.

Sometimes you can get a discount by paying a bill within a few days after receiving it. Some bills, on the other hand, have penalty charges added to them if they are not paid on the date due.

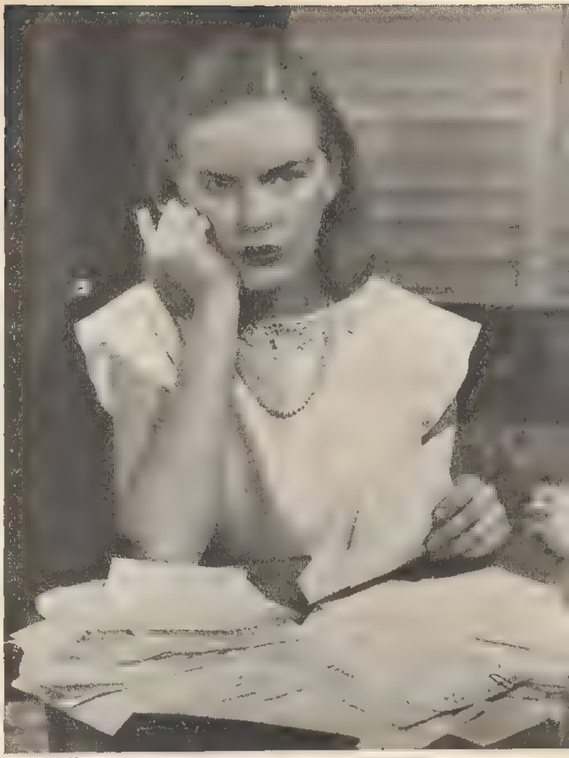
PROBLEMS

1. In December Mr. Fowler bought $48.00 worth of goods from a store which allows a 3 per cent discount on bills paid before the tenth of each month. How much did he save by paying the bill on January 9 instead of on January 11?

2. Mrs. Carlton buys all of her groceries at the same store and pays for them monthly. In order to encourage prompt payments, the grocer allows a 3 per cent discount on all bills paid before the 10th of the month. If she pays her March bill of $48.50 on April 6, how much does she save?

3. In one city a 10 per cent penalty is added to water bills if they are not paid on the date due. The water bills are sent out four times a year. If Mr. Forster has an average quarterly bill of $3.15, how much does he save each year by paying the bills when due?

4. The monthly payment on Mr. Kent's house is $45.80. His agreement with the bank states that he must pay an additional 5 per cent if the payment is not made by the 15th of the month. Last year he made all his payments by the 15th of the month, except those due in January, August and October. How much extra did these delays cost him?



GALLOWAY

If you don't pay your bills promptly, they may pile up, as this young lady seems to have discovered.

5. If Mr. Harding does not pay his gas bill when due, 5 cents per 1000 cubic feet is added. He uses 9000 cubic feet per month. How much does he save per year by paying his bills on time?

6. Mr. Turner receives a lodge insurance bill of $2.20 each month. If he does not pay the bill promptly, $.25 is added to it. If he should pay none of the bills when due, how much would the cost of his insurance be increased each year?

7. Each of the following pieces of furniture was sold at a 7 per cent discount for cash:

Wing chair	$129.50
Love seat	179.50
Lawson sofa	259.50

Find the cash price of each piece.

8. Each of the following articles was sold at a discount of 12 per cent for cash:

Vacuum cleaner	$44.95
Desk chair	7.25
Aluminum bathinette	18.75

Find the cash price of each.

9. If property taxes are not paid on the date due, 10 per cent is often added to the bill. How much would this penalty increase a tax bill of $105.50?

10. Mr. Martin neglected to file and pay his Federal income tax on March 15, and as a result paid a penalty of 5 per cent of the tax due. How much did the penalty increase his Federal income tax of $285.70?

When You Buy by Mail

Many people — those who live in remote districts, shut-ins, mothers with small children, people whose working hours are the same as store hours, and those who just like the convenience of shopping at home — order goods from the catalogs of mail-order houses. When you buy by mail, you must figure your own bill, add the sales tax if your state or city has one, and determine the shipping charges on your order. Over half the states levy retail sales taxes, usually between 1 and 3 per cent of the purchase price of the goods.

A mail-order catalog gives you a chance to decide at your leisure between similar articles at different prices.

GALLOWAY

Sales Taxes

When you buy in a store, the sales clerk figures the tax for you. When you buy by mail, you must calculate the tax yourself.

To take care of fractions of a cent, some states issue coins in denominations less than one cent; others have schedules of charges such as this:

Amount of Purchase	*Tax*
Less than $.09	None
$.09 to $.40	$.01
$.41 to $.70	$.02
$.71 to $1.08	$.03
Each additional dollar	$.03

In figuring the sales tax on a mail-order purchase, you should count any fraction of a cent as a whole cent.

PROBLEMS

Figure the cost of each of the following mail orders, including state sales tax.

1. Mr. Stearns, of Toledo, Ohio, sent a mail order for the following articles:

1 paint brush	$5.29
1 gallon floor varnish	4.59
1 broadcloth shirt	3.65
1 leather belt	4.15

Use the sales tax schedule given on page 200 in finding the cost of Mr. Stearns' order.

2. H. P. Grant of Laddonia, Kansas, ordered the following supplies by mail:

5 lb. steel fence anchors at $.18 per lb.
1 post hole digger at $2.49
1 pressure lubricator at $9.48

Find the cost of Mr. Grant's order, including a 2 per cent sales tax.

3. R. C. Collins of R.F.D. No. 3, Dover, Missouri, sent the following mail order:

1 oil burning brooder at $14.95
1 egg candler at $1.45
6 steel chick feeders at $.75 each

Find the cost of Mr. Collins' order, including a 2 per cent sales tax.

4. Mr. Fuller of Farmville, North Carolina, sent a money order for the following goods:

2 pair men's overalls at $5.75 a pair
50 steel fence posts at $.455 each
1 pony saddle at $39.50

What did the goods cost, including the North Carolina sales tax of 3 per cent?

5. Mr. Bernard of Crawford, Michigan, ordered the following seeds from a seed company:

5 lb. lima beans at \$.32 per lb.
4 lb. bush beans at \$.25 per lb.
12 lb. hybrid sweet corn at \$.38 per lb.
6 lb. peas at \$.23 per lb.
3 oz. lettuce at \$.20 per oz.

Find the cost of the seeds, including the Michigan sales tax of 3 per cent.

The Weight of Your Order

To figure the shipping charges on an order, you must know the weight in pounds of the goods to be sent. Mail-order catalogs tell the weight of each article just as they tell the price.

PROBLEMS

In finding the weights of these orders, count any fraction of a pound in the total weight as a whole pound.

1. Bill ordered the basketball equipment the neighborhood team required from a mail-order house. His order included 7 shirts and 7 pair of basketball pants and 2 basketballs. The shipping weights were as follows: shirts, 8 oz. each; pants, 12 oz. each; balls, 2 lb. 3 oz. each. What was the total shipping weight?

2. Mary ordered a tennis racket, a racket cover, a racket press, and 1 dozen tennis balls from a mail-order house. The shipping weight of the racket was 2 lb., that of the cover was 2 oz., and that of the press was 2 lb. 3 oz. The shipping weight of 3 balls was 12 oz. What was the shipping weight of the order?

3. Mrs. Harris ordered a two-quart saucepan, a three-quart saucepan, a covered casserole, and 3 cake tins from a mail-order house. The weights of the saucepans were 2 lb. 9 oz. and 3 lb. 2 oz., that of the casserole was 4 lb. 4 oz. The cake tins weighed 11 oz. each. What was the shipping weight of the order?

4. Mrs. Carlson ordered some Christmas presents from a mail-order house. Her order was as follows:

Item	*Price*	*Shipping Weight*
1 doll with crying voice	$3.79	2 lb.
1 heart-shaped locket	2.59	4 oz.
1 scooter	3.89	10 lb.
2 toy automobiles	1.19 each	2 lb. 8 oz. each
2 pair ice skates	6.25 pair	2 lb. 12 oz. each

Find the total cost and total shipping weight.

5. Mr. Nielsen ordered automobile supplies as follows:

Item	*Price*	*Shipping Weight*
1 set seat covers	$6.95	4 lb. 4 oz.
1 seat cushion	1.49	3 lb. 4 oz.
1 floor mat	2.59	7 lb.
2 cans liquid cleaner	.39 each	2 lb. 4 oz. each
2 cans wax	.39 each	9 oz. each

Find the total cost and total shipping weight.

Parcel-Post Charges

When you buy by mail, you will probably have your order sent to you by parcel post, also called *fourth-class mail.* Parcel post may be used for packages weighing up to 70 pounds, whenever the sum of the length of the package and the shortest distance around it is not greater than 100 inches.

Table 4. UNITED STATES PARCEL-POST ZONES

Distance	*Zone*
Up to 150 miles	1 and 2
150 to 300 miles	3
300 to 600 miles	4
600 to 1000 miles	5
1000 to 1400 miles	6
1400 to 1800 miles	7
Over 1800 miles	8

To find the charge for parcel-post service, you must know not only the weight of the package to be sent, but also the distance it must travel. Distances are expressed in terms of *zones*, as shown in Table 4 on page 203.

By using a map and the scale of miles that accompanies it, you can determine what zone one place is in with respect to another. For example, the map in Figure 5–1 shows El Paso and Los Angeles almost $1\frac{3}{8}$ inches apart. According to the scale of miles, $1\frac{3}{8}$ inches represents 700 miles; so Los Angeles is in the fifth zone with respect to El Paso. Cheyenne is $\frac{7}{8}$ inch from Omaha, or about 450 miles. Therefore Cheyenne is in the fourth zone with respect to Omaha. Louisville is almost $3\frac{3}{4}$ inches from San Francisco on the map, or between 1800 and 1900 miles. So Louisville is in the eighth zone with respect to San Francisco.

A part of the post-office schedule of rates for parcel-post service is given in Table 5. By using it, you can determine the cost of sending packages by mail.

Figure 5-1

Table 5. CHARGES FOR PARCEL POST SERVICE ON PACKAGES UP TO TWENTY-FIVE POUNDS

No. of lbs.	Local	Zones						
		1–2 Up to 150 miles	3 150 to 300 miles	4 300 to 600 miles	5 600 to 1000 miles	6 1000 to 1400 miles	7 1400 to 1800 miles	8 Over 1800 miles
1	$0.10	$0.12	$0.13	$0.14	$0.15	$0.16	$0.17	$0.18
2	.11	.15	.16	.19	.21	.24	.27	.30
3	.12	.17	.19	.23	.27	.31	.36	.41
4	.13	.19	.22	.28	.33	.39	.46	.53
5	.14	.21	.25	.32	.39	.46	.55	.64
6	.15	.23	.28	.37	.45	.54	.65	.76
7	.16	.25	.31	.41	.51	.61	.74	.87
8	.17	.27	.34	.46	.57	.69	.84	.99
9	.18	.29	.37	.50	.63	.76	.93	1.10
10	.19	.31	.40	.55	.69	.84	1.03	1.22
11	.20	.33	.43	.59	.75	.91	1.12	1.33
12	.21	.35	.46	.63	.80	.98	1.21	1.44
13	.22	.37	.49	.68	.86	1.06	1.31	1.56
14	.22	.39	.52	.72	.91	1.13	1.40	1.67
15	.23	.41	.54	.76	.97	1.20	1.49	1.78
16	.24	.43	.57	.80	1.02	1.27	1.58	1.89
17	.25	.45	.60	.85	1.08	1.35	1.68	2.01
18	.25	.47	.63	.89	1.13	1.42	1.77	2.12
19	.26	.49	.66	.93	1.19	1.49	1.86	2.23
20	.27	.51	.68	.97	1.24	1.56	1.95	2.34
21	.28	.53	.71	1.02	1.30	1.64	2.05	2.46
22	.28	.55	.74	1.06	1.35	1.71	2.14	2.57
23	.29	.57	.77	1.10	1.41	1.78	2.23	2.68
24	.30	.59	.80	1.14	1.46	1.85	2.32	2.79
25	.31	.61	.82	1.19	1.52	1.93	2.42	2.91

PROBLEMS

Refer to Tables 4 and 5 as you solve the following problems.

1. Find the cost of sending each package by parcel post, using the weight and zone as given below:

	Weight	Zone		Weight	Zone
a.	23 lb.	5	**c.**	13 lb.	8
b.	1 lb.	1	**d.**	20 lb.	2

2. Find the postage on each of the following packages:

	Weight	*Zone*
a.	25 lb.	4
b.	18 lb.	6
c.	12 lb.	3
d.	21 lb.	7

3. Find the cost of sending each of the following packages by parcel post, using the weight and distance given below:

	Weight	*Distance*
a.	5 lb.	100 miles
b.	25 lb.	1100 miles

4. How much is the postage in each of the following cases:

	Weight	*Distance*
a.	14 lb.	350 miles
b.	7 lb.	1900 miles

5. How much does it cost to have a 12-pound package sent by fourth-class mail from Denver, Colorado, to Jacksonville, Florida?

6. How much does it cost to have a 22-pound package sent by fourth-class mail from Denver, Colorado, to Seattle, Washington?

7. Mr. McLeod, who lives on a farm near St. Louis, purchased some clothing from a mail-order house in Chicago. How much postage must he send, if the package weighs 23 pounds?

8. Mr. Meyer lives near Minneapolis. He sent an order to Detroit for a part to a farm machine. If the package weighed 12 pounds, how much postage did he send?

9. John T. Bullowa sent the following order to a mail-order house about 250 miles from his home. The sales tax in his state is 2%. Find the total amount Mr. Bullowa must send with his order.

Item	*Price*	*Shipping weight*
1 claw hammer	$1.35	2 lb.
1 hatchet	1.69	2 lb. 6 oz.
1 jack plane	3.69	5 lb. 12 oz.

10. Margaret C. Hodge ordered the following supplies by mail:

Item	*Price*	*Shipping weight*
1 garment bag	$5.89	3 lb.
1 tablecloth	3.79	1 lb. 7 oz.
1 coat sweater	2.98	1 lb. 2 oz.

Mrs. Hodge lives in a state having a 2% sales tax, about 230 miles from the city in which the mail-order store is located. Find the total amount she must send with her order.

11. Susan Tilson sent an order for her spring outfit to a mail-order house 340 miles from her post office. She lives in a state that collects a 3% sales tax. Find the total amount of money that Susan should have included when she sent the following order:

Item	*Price*	*Shipping weight*
1 rayon dress	$ 5.95	1 lb. 11 oz.
1 tweed coat	12.95	3 lb. 13 oz.
1 pair dress shoes	3.98	1 lb. 2 oz.
1 pair white gloves	.98	4 oz.

12. Richard Harrison ordered some photographic equipment from a mail-order house located about 280 miles from his town. He lives in a state that charges a 3% sales tax. Find the total amount of money that Richard should have sent with the following order:

Item	*Price*	*Shipping weight*
1 contact printer	$ 3.98	4 lb. 5 oz.
1 light meter	14.95	1 lb. 5 oz.
1 yellow filter	1.95	3 oz.
1 flash gun	8.95	1 lb. 14 oz.

Freight Charges

The least expensive way to ship heavy or bulky goods is by rail freight. The smallest charge is the rate for 100 pounds; but if this rate is less than $1.00, the minimum charge is $1.00. When a shipment weighs over 100 pounds, it is charged according to its weight. Of course, the distance that goods

are shipped also affects the charges. The charges are fixed by the transportation companies, and ordinarily you pay the charges when the shipment is received. The companies are required to collect a Federal tax of 3 per cent on all rail shipments.

Example Mr. Keith wishes to order a six-piece dinette set from a mail-order house 200 miles from his home. The price is $72.95, and there is no sales tax. The shipping weight is 170 pounds. If the freight rate is $1.46 per hundred pounds, how much will the dinette set cost Mr. Keith?

What to Do	How to Do It
(1) Find the freight charge.	170 ÷ 100 = 1.7 1.7 × $1.46 = $2.482, or $2.48
(2) Find the Federal tax.	.03 × $2.48 = $.0744, or $.07
(3) Add the freight charge and the Federal tax to the price of the merchandise.	$2.48 + $.07 + $72.95 = $75.50 Answer

PROBLEMS

Don't forget to add the Federal tax in solving these problems.

1. Mrs. Pearse ordered a desk priced at $69.85. The shipping weight was 130 pounds, and the freight rate, $1.07 per 100 pounds. What was the total cost to Mrs. Pearse?

2. Mrs. Crowell ordered a kitchen cabinet priced at $74.50. The shipping weight was 175 pounds and the freight rate, $1.46 per 100 pounds. What was the total cost to Mrs. Crowell?

3. A mail-order catalog gives the price of a chair as $24.95 and the shipping weight as 55 pounds. If the freight rate is $2.12 per 100 pounds, what is the total cost of the chair?

4. A mail-order catalog gives the price of a table radio as $32.50 and the shipping weight as 35 pounds. If the

freight rate is $1.46 per 100 pounds, what is the total cost of the radio?

ROBERTS

A great many people ship goods by freight, as these freight cars in a railroad terminal indicate.

5. A mail-order catalog gives the price of a laundry tub as $16.25 and the shipping weight as 350 pounds. Mr. Kent, who lives about 200 miles from the mail-order house, learns that the freight rate is $1.39 per 100 pounds. Find the total cost of the laundry tub.

6. A mail-order house gives the price of a plow as $147.50 and the shipping weight as 680 pounds. Mr. Kearney, who lives about 100 miles from the mail-order house, finds that the freight rate is $.79 per 100 pounds. How much will the plow cost him?

7. Mr. Hammond, who lives in a state collecting a 3 per cent sales tax, bought a furnace priced at $126.50 and having a shipping weight of 775 pounds. The freight rate was $.83 per 100 pounds. How much did the furnace cost him?

8. Mr. Armstrong, who lives where a 2% sales tax is levied, purchased a pressure water pump priced at $92.50. The freight rate was $1.70 per 100 pounds and the shipping weight of the pump was 175 pounds. How much did the pump cost Mr. Armstrong?

9. Mr. and Mrs. Danforth selected the following furniture for the living room of their new home:

Item	*Price*	*Shipping weight*
Channel-back chair	$37.95	45 lb.
Drum-top table	21.95	25 lb.
Fan-back chair	29.95	35 lb.
Duncan Phyfe sofa	139.50	215 lb.

The freight rate for furniture from the supply house to their station is $1.46 per hundred pounds. Their state collects a 1 per cent sales tax. What was the total cost of the Danforths' new furniture?

10. When doing over her kitchen, Mrs. Long ordered the following equipment:

Item	*Price*	*Shipping weight*
Cabinet sink	$86.95	230 lb.
Wall cabinet	28.95	85 lb.
Storage base	21.48	40 lb.
Table and four chairs	59.95	128 lb.

The rate for freight shipment was $1.04 per hundred pounds. How much did the equipment cost Mrs. Long, including the sales tax of 3%?

What You Should Know About Installment Buying

Because some articles, such as household equipment, cost a large amount, many persons find it necessary at times to buy on the installment plan. You should understand the installment transaction, so that you can decide under what conditions this convenience is worth the extra expense involved.

A person who buys on the installment plan pays only part of the price when he receives the article. He owes the dealer the rest of the price. Thus installment buying is borrowing, and the dealer wants some return on the money he lends. The purchaser pays interest on the borrowed money. This interest makes installment buying more expensive than buying for cash. Consequently, many persons prefer to postpone purchases until they can pay cash. They save regularly in advance, instead of making regular payments later. Thus they receive interest on their savings; they do not pay interest on debts.

Here is a list of the terms commonly used with reference to installment buying:

Down payment: cash paid when the article is purchased
Balance due: amount the purchaser owes the dealer
Carrying charge: amount the purchaser pays as interest
Unpaid balance: balance due plus carrying charge


"Psst!"
"Hey!"
"Ahem!"
"Now!"
"You forgot me!"
"Well?"
"Pay!"

How to Find the Carrying Charge

You can find the carrying charge on an installment purchase if you know the cash price of the article and know or can calculate how much the purchaser pays in all. Subtract the cash price from the total amount the buyer pays.

Example A dealer offered a radio for $55.60 cash. If the radio is purchased on the installment plan, a down payment of $5.00 and 36 weekly payments of $1.50 are required. How much is the carrying charge?

What to Do	How to Do It
(1) Find the total amount of the weekly payments.	36 × $1.50 = $54.00
(2) Add the down payment to the total of the installments.	$54.00 + $5.00 = $59.00
(3) Subtract the cash price from the sum.	$59.00 − $55.60 = $3.40 Answer

PROBLEMS

Some of these problems are more complicated than the example above; so read each problem carefully to be sure you know what to do to find the solution.

1. Mr. Kramer wished to buy an all-steel farm trailer priced at $139.50 cash. As he did not have the required cash, he paid $14.50 down and the balance in 13 equal monthly payments of $10.00 each. How much carrying charge did he pay?

2. Mrs. Armstrong bought an electric range priced at $244.50. She made a down payment of $49.50 and then paid $18.00 per month for 11 months and $9.00 the twelfth month. Find the carrying charge.

3. Mr. Crowell wished to buy an electric pump. The dealer told him that the price was $78.60 and that if he would pay $15.00 down he could have 6 months to pay the balance and

no carrying charge would be added. The dealer would allow Mr. Crowell an 8 per cent discount for cash. What charge was the dealer really making as a carrying charge?

4. Mrs. James bought a washing machine priced at \$150.00 cash. She paid \$30.00 down, and agreed to pay the balance plus a carrying charge in twelve equal monthly payments. The carrying charge was 6 per cent of the balance remaining after the down payment. Find the carrying charge.

5. A radio priced at \$113.00 may be bought on the installment plan by making a $\frac{1}{3}$ down payment and paying a carrying charge of 5 per cent of the balance due. Find the carrying charge.

Rate of Interest

When considering an installment purchase, you should know the *rate* at which interest is charged. The rate of interest is a *per cent* of the amount owed. It is usually expressed as an annual rate; that is, as a per cent *per year*.

Do you see how the interest rate differs from the carrying charge? The carrying charge is the amount of interest — a certain number of dollars and cents. You need to know the

Both the store windows shown here suggest that you buy on the installment plan. Notice that neither gives you the information you need in order to decide intelligently whether or not to do so. You must find out the rate of interest for yourself.

STAR BLACK STAR

amount of interest in order to compute the interest rate. You also need to know the amount owed and the length of time for which the money is owed.

To learn how to compute an interest rate, first consider the case of a man who borrows \$120 on February 1 and promises to pay it back on June 1, plus \$3 interest. He has the use of \$120 for four months.

The amount owed is . .	\$120
The length of time is . .	4 months = $\frac{1}{3}$ year
The amount of interest is .	\$3

The annual rate of interest is found like this:

(1) Multiply the debt by the length of time in years

$$\tfrac{1}{3} \times 120 = 40$$

(2) Divide the amount of interest by the product

$$\begin{array}{r} .075 \\ 40\overline{)3.000} \\ \underline{2\,80} \\ 200 \\ \underline{200} \\ 0 \end{array}$$

(3) Express the quotient as a per cent

$$.075 = 7\tfrac{1}{2}\% \quad \text{Annual rate of interest}$$

Now consider the case of another man who borrows \$120 on February 1. This borrower promises to pay back the money in *monthly installments* of \$30, plus \$3 interest on June 1. He has the use of \$120 for only one month, February. During March he has the use of \$90; during April, of \$60; during May, of \$30. On the average, he has the use of \$75 for the four months during which he is in debt. (The sum of \$120, \$90, \$60, and \$30, divided by 4, equals \$75.)

The amount owed is . .	\$75
The length of time is . .	4 months = $\frac{1}{3}$ year
The amount of interest is .	\$3

The annual rate of interest is found as before:

(1) Multiply the debt by the length of time in years

$$\tfrac{1}{3} \times 75 = 25$$

(2) Divide the amount of interest by the product

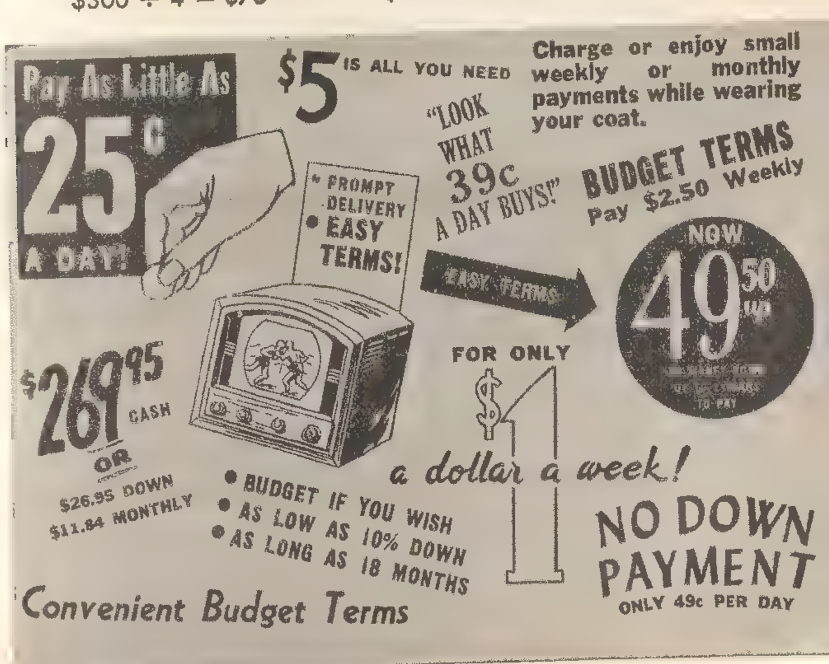
$$\begin{array}{r} .12 \\ 25\overline{)3.00} \\ \underline{2\,5} \\ 50 \\ \underline{50} \\ 0 \end{array}$$

(3) Express the quotient as a per cent

$$.12 = 12\% \quad \text{Annual rate of interest}$$

Whenever a debt is paid in installments, the *average amount owed* is used in calculating the rate of interest. An easy way to find the average amount owed is to take half the sum of the amount owed before the first installment is paid and the amount owed before the last installment is paid. For example, in the case of the man who paid back $120 in $30 installments, you could add all four debts and divide by 4, or you could add the first and last debts and divide by 2. The result is the same:

$$\begin{array}{rcl} \$120 + \$90 + \$60 + \$30 = \$300 & \qquad & \$120 + \$30 = \$150 \\ \$300 \div 4 = \$75 & \qquad & \$150 \div 2 = \$75 \end{array}$$



Newspaper advertisements make installment buying seem easy, but a person who buys many articles this way may find it hard to keep up payments.

Since installment buying is a form of borrowing, the interest rate on installment purchases is calculated in just the same way as the interest rate on borrowed money. You must know three facts: the carrying charge, the average debt, and the length of time before the purchase is completely paid for.

Example

A dealer offered a fur coat for \$174 cash or \$60 down and \$20 a month for 6 months. What is the rate of interest if the coat is sold on the installment plan?

What to Do	How to Do It
(1) Find the amount of interest; that is, the carrying charge.	$6 \times \$20 = \$120$ $\$120 + \$60 = \$180$ $\$180 - \$174 = \$6$
(2) Find the average debt.	Debt the first month: $\$174 - \$60 = \$114$ Paid before last month: $5 \times \$20 = \$100$ Debt the last month: $\$114 - \$100 = \$14$ Sum of first and last debts: $\$114 + \$14 = \$128$ Average debt: $\$128 \div 2 = \$64$
(3) Express the length of time in years.	6 months $= \frac{1}{2}$ year
(4) Calculate the annual interest rate.	$\frac{1}{2} \times 64 = 32$ $6 \div 32 = .1875 = 18.75\%$ **Answer**

PROBLEMS

In solving these problems, remember that the debt does not include the carrying charge, for the carrying charge is the interest on the debt. Think of the carrying charge as being paid after all the money that is owed.

1. Mr. Gray bought a walnut finished table. The cash price was \$34.95. He paid \$7.50 down and the balance in six

equal monthly payments of $5.10 each. Find the rate of interest that Mr. Gray paid on his purchase.

2. Thomas King bought a bicycle on the deferred payment plan. He paid $10.00 down and the balance in four equal monthly payments of $7.25 each. If the cash price was $36.50, at what rate did he pay interest?

3. Mrs. Judge bought a set of twin beds at $117.00. She made a down payment of $20.00 and paid the balance in 12 equal monthly installments of $8.58 each. What rate of interest did she pay?

4. The cash price of a vacuum cleaner was $65.40. Mrs. King bought it on the deferred payment plan, paying $15.00 at the time of the purchase, and the balance in 12 weekly installments of $4.50 each. At what rate was interest charged?

5. Susan bought a coat for $29.50. She paid $3.00 down and $5.80 a month for five months. Find the rate of interest.

6. Sylvia bought a fur coat for $175.80 and made a down payment of $25.80. She agreed to pay $13.50 a month for 12 months. Find the rate of interest.

7. Robert bought a rifle priced at $24.95 cash and made a down payment of $2.50. He agreed to pay five monthly installments of $5.50 each. What rate of interest did Robert pay?

8. Mildred bought a typewriter priced at $120.00 and made a down payment of $12.00. She paid ten monthly installments of $12.00 each. What rate of interest did Mildred pay?

9. Dick bought a watch for $35.80. As he bought it on the installment plan, he was required to make a down payment of $7.50 and pay six monthly installments of $5.00 each. Find the rate of interest.

10. The cash price of a violin was $150. Pat bought it on an installment plan which required a down payment of $50 and five monthly installments of $22 each. What rate of interest was Pat charged?

What You Have Learned in This Chapter

1. To figure the amount of money saved when you buy nonperishable articles in large amounts rather than small amounts
2. To figure the percentage saving resulting when you buy at sale prices rather than at regular prices
3. To find the savings made possible by paying cash and by paying bills promptly
4. To compare the costs of goods per unit of weight or volume
5. To make comparisons of articles in terms of quality in relation to use
6. To figure sales taxes
7. To figure parcel-post charges and freight charges
8. To find carrying charges on installment purchases
9. To compute the rate of interest charged on installment purchases
10. To understand the following terms: *credit rating, down payment, balance due, carrying charge, unpaid balance*

Review Test on Spending Wisely

1. Mr. Foster uses lime on his farm land. He can buy lime in 50-pound bags at $.42 or at $15.00 per ton. If he uses 3 tons, how much does he save by buying it in the larger lots?

2. How much is saved by buying a 5-gallon can of oil for $5.15 rather than 5 gallons of oil at $.31 per quart?

3. Mr. Harris wished to have a radio installed in his automobile. He was interested in one priced at $72.50. One day he saw this radio advertised for $64.95. If he bought it at the sale price, what per cent of the regular price did he save?

4. A six-ply automobile tire priced at $14.75 is guaranteed to have 50% more mileage than a four-ply tire of the same size

and make, priced at $12.45. Mr. Fox has been using four-ply tires and getting about two years service from them. Which kind of tire should he order, if he expects to keep his present car indefinitely? Explain your answer.

5. A dresser marked at $66.50 was sold at a $12\frac{1}{2}$ per cent discount. If the purchaser paid cash, how much did the dresser cost him?

6. J. C. Carter ordered the following items by mail:

1 water heater	$15.95
1 sink faucet combination	$7.85
3 safety switches at $2.09 each	

He must also pay a 3 per cent sales tax. Find the cost of Mr. Carter's order, apart from shipping charges.

7. Harold ordered the following equipment for the neighborhood baseball team he managed: 3 bats, 6 balls, 1 first baseman's mitt, 4 fielder's gloves. The shipping weights were as follows: 1 bat, 3 lb.; 1 ball, 8 oz.; first baseman's mitt and fielder's gloves, 1 lb. 4 oz. each. Find the shipping weight of the total order.

8. Mr. Gibson ordered a gas stove from a mail-order house 300 miles from his home. The price was $254.95 and there was no sales tax. The shipping weight was 423 pounds, and the freight rate was $1.50 per 100 pounds. How much did the stove cost Mr. Gibson? (Don't forget the Federal tax.)

9. A certain furniture store will allow a 10 per cent discount for cash and will sell on the deferred payment plan without adding a carrying charge. If Mrs. Williams bought a chair and desk at this store for $85.50 on the deferred payment plan, how much carrying charge did she pay?

10. Howard Gray bought four new tires for his automobile. The cash price for the four tires was $55.60. At the time of the purchase he paid $18.60. Each month thereafter for four months he paid $10. Find the rate of interest.

How do you rate?	Excellent	Good	Fair	Poor
	10	8–9	6–7	5 or less

CHAPT

6

BLACK STAR

1. Collect and examine sales slips and charge-account bills from various stores in and near your community. Notice how the sales slips and bills are receipted.
2. Get actual bills for electricity, gas, water, and telephone service. Find the rates used in figuring these bills. Verify the charges.
3. Locate the various meters in your home. Bring to class copies of the dials, showing the positions of the hands. Practice reading meters.
4. Examine the markings on various electric appliances to find which are marked in watts, which in horsepower, and which in volts and amperes.
5. By watching the small dial on a gas meter when only one gas appliance is in use, find out how much gas that appliance consumes in a stated length of time—15 minutes, a half hour, an hour, etc.
6. Examine the first few pages of a telephone directory. Compare the costs of the various kinds of telephone service available in your community.

HOUSEHOLD BILLS

A PERSON WHO MANAGES his money well counts his change when he receives it and examines sales slips and bills. He compares the goods and services listed with those he actually receives, and he checks the computations shown on the slips and bills. He keeps receipts until he is sure no question will arise about them.

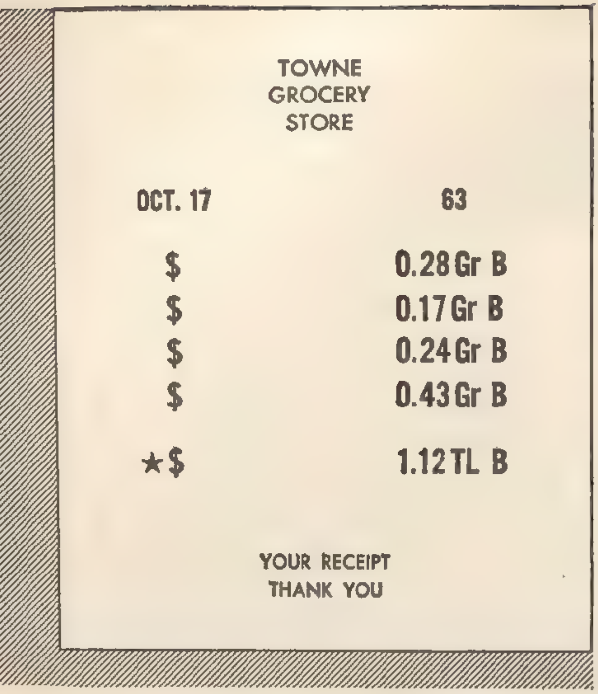
Sales Slips and Charge-Account Bills

When you give money to a sales clerk or cashier in exchange for goods or services, you usually receive change and a receipt. If you are wise, you count your change at once, and you take your receipt home with you for later checking.

Your receipt may merely be a slip from a cash register, as it often is in grocery stores. (See Figure 6–1 on page 222.) It may be a sales slip, filled in by the clerk who sold you the goods. (See Figure 6–2 on page 224 and the photograph on page 225.) If you are paying a bill, the person who takes your money may merely stamp the bill "Paid" or "Received payment" and add the date and his name or initials.

Counting Change

Have you ever noticed how a clerk or cashier makes change? He gives you the smallest number of pieces of money possible, and always gives money of small denominations before money of larger denominations. As he hands you your change, he first states the price of your purchase. Then he adds to it the amount of the coins and bills as he hands them to you. When he has finished, the sum is equal to the amount of money you gave him. For example, suppose you give a sales clerk $2.00 to pay for an article costing $1.12.


TOWNE
GROCERY
STORE

OCT. 17 63

$ 0.28 Gr B
$ 0.17 Gr B
$ 0.24 Gr B
$ 0.43 Gr B

★$ 1.12 TL B

YOUR RECEIPT
THANK YOU

Figure 6–1

He says:	$1.12,	$1.15,	$1.25,	$1.50,	$2.00
He hands you:		3 pennies,	1 dime,	1 quarter,	1 half dollar
You receive:		$.03 +	$.10 +	$.25 +	$.50 = $.88

You check: $2.00 − $1.12 = $.88

PROBLEMS

1. Suppose you purchased a bag of apples for $.29 and gave the clerk $1.00.

a. What should the clerk say as he hands the change to you?

b. What coins should you receive?

c. What amount should you receive?

2. If you buy a comb for $.19 and give the clerk a dollar bill:

a. What should the clerk say while handing you your change?

b. What coins should you receive?

c. How much money should you receive?

3. What should a cashier say in making change in these cases:

a. $.20 out of $1.00

b. $2.26 out of $3.00

c. $7.04 out of $10.00

d. $2.15 out of $5.00

9 1
10 0 0
7 6
2 2 4

4. What should a clerk say in making change in the following instances:

a. $.15 out of a dollar

b. $1.27 out of $2.00

c. $3.06 out of $5.00

d. $2.45 out of $10.00

4 9 1
5 0 0
3 0 6
1 4

9 9 1
10 0 0
2 4 5
7 5 5

5. Mrs. Clarke bought 2 pounds of spare ribs at $.38 per pound and gave the clerk $2.00. What coins should she receive in change?

6. Wilbur bought two tickets to a football game at $.60 each, and gave the ticket seller $1.50. What coins should he receive in change?

7. Mr. Taylor bought a tube of tooth paste for $.49; some razor blades for $.48; a magazine for $.25; and sun glasses for $2.50. He gave the clerk a $10 bill.

a. Show how to count his change.

b. How much change should he receive?

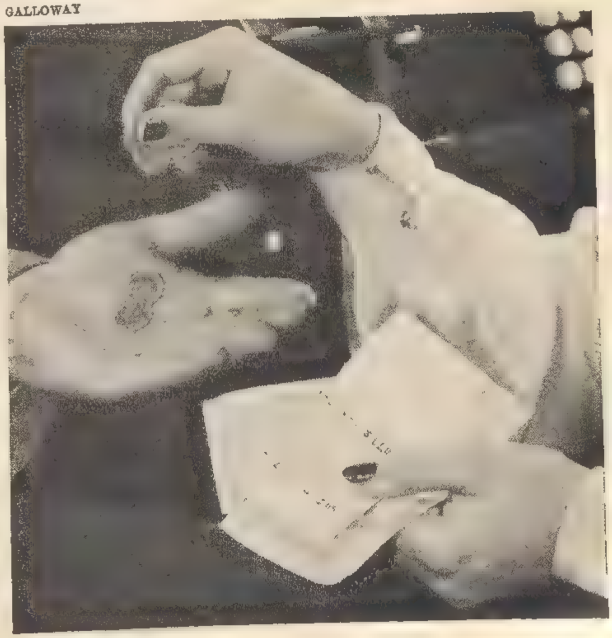
8. Mr. Leonard bought a pair of shoes at $10.97 and a hat at $12.33. He gave the clerk three $10 bills.

a. Show how to count his change.

b. How much change should he receive?

Notice that the clerk is handing the customer his small change before giving him the bills.

GALLOWAY



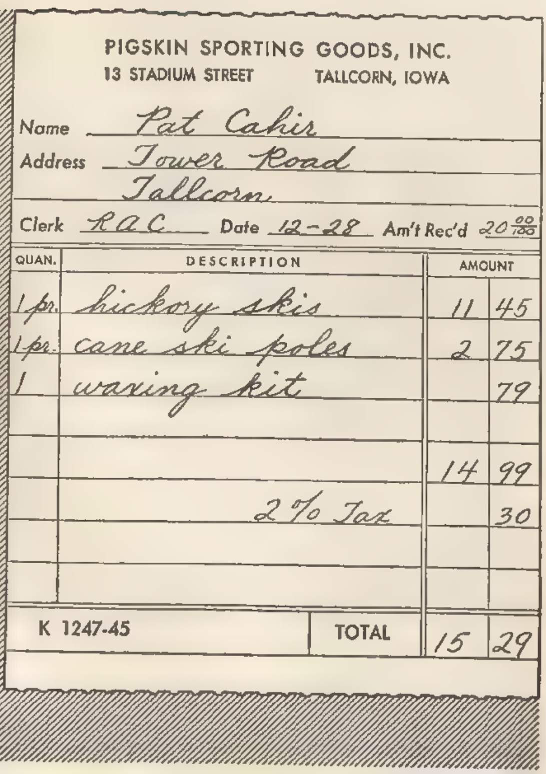
9. Mildred Meyers bought groceries costing $4.22 and gave the clerk a $20 bill. She next went to the meat market and bought meat costing $2.87, giving the clerk the larger of the two bills she had received. If each clerk gave her the least possible number of bills and coins in change, what coins and bills did she have when she left the meat market?

10. Sam Hartwell bought a shirt for $3.15 and gave the clerk a $10 bill. He next went to the bakery and purchased bread and rolls costing $.87, giving the clerk the larger of the two bills he had received. If each clerk gave Sam the least possible number of bills and coins in change, what bills and coins did he have when he left the bakery?

Sales Slips

A sales slip shows the cost of each item you bought and the total cost, including the tax, if there is one. It also shows the amount of money you gave the clerk. It tells who made the sale and often also bears the name and address of the purchaser. Examine the sales slip in Figure 6–2 to learn how these pieces of information may be recorded.

Figure 6–2



PIGSKIN SPORTING GOODS, INC.
13 STADIUM STREET TALLCORN, IOWA

Name Pat Cahir
Address Tower Road
Tallcorn
Clerk RAC Date 12-28 Am't Rec'd 20 00/100

QUAN.	DESCRIPTION	AMOUNT	
1 pr.	hickory skis	11	45
1 pr.	cane ski poles	2	75
1	waxing kit		79
		14	99
	2% Tax		30
K 1247-45	TOTAL	15	29

PROBLEMS

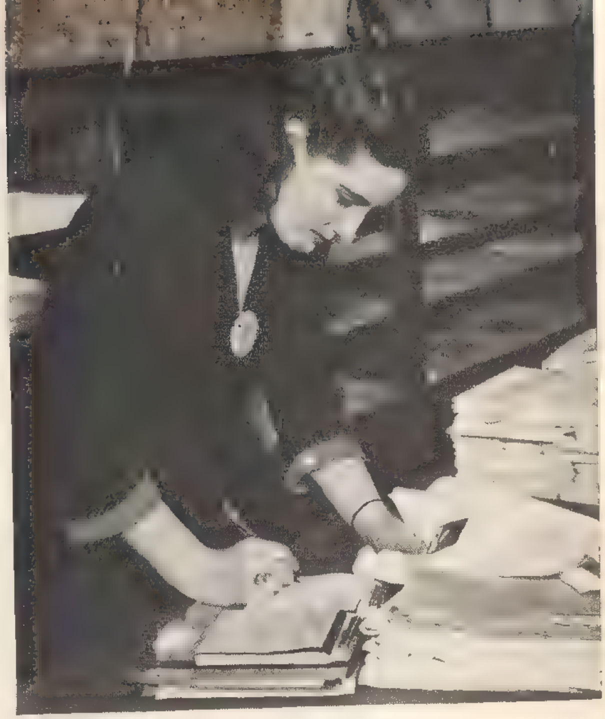
1. Yesterday Mrs. R. A. Selkirk of 1575 Maple Avenue, Peninsula, Florida, purchased the following articles at the West Side Fruit and Vegetable Market:

1 lb. butter at $.85
1 box potato chips at $.37
2 packages sandwich buns at $.12 each
1 cake at $.65
2 doz. eggs at $.79 per doz.

She gave the clerk a $5 bill in payment. There was no sales tax.

a. How much change should Mrs. Selkirk have received?

b. Make a sales slip for Mrs. Selkirk.



GALLOWAY

Notice the sales book this clerk is using. She is copying information from the label to the sales slip.

2. Today Mrs. James Samuels of 45 East 85 Street, Columbus, Georgia, purchased the following articles at the West Branch Drug Company.

1 bottle shampoo at $1.00
2 boxes of safety matches at $.08 each
1 first-aid kit at $.87
1 bottle of vitamin tablets at $2.89
2 tubes tooth paste at $.39 each

Mrs. Samuels paid for her purchases with a $10 bill. There was no sales tax.

a. How much change should Mrs. Samuels have received?

b. Make a sales slip for the transaction.

3. If the sales tax is 3 per cent and the amount given in payment $5, make out a sales slip for these purchases:

3 doz. clothes pins at $.39 per doz.
1 clothes line at $.48
1 metal vegetable bin at $2.98

4. Make out a sales slip for the following transaction:

1 blouse at $6.98
1 pair pajamas at $3.50
3 handkerchiefs at $.35 each

The sales tax is 2 per cent, and the amount given in payment, $15.

5. Mrs. Brian, who lives in a state that does not have a sales tax, received a sales slip showing that she had made the following purchases:

1 pair house slippers	$2.98
2 pairs wool socks at $1.25 each	2.50
3 balls yarn at $.55 each	1.55
1 muffler	1.35
	$9.23

a. What errors were made?

b. How much should Mrs. Brian have been charged for her purchases?

6. Mrs. Dwyer, who lives where there is no sales tax, found errors in this sales slip:

2 neckties at $1.60 each	$3.20
1 shower curtain	4.95
12 glass tumblers at $.06 each	.68
1 vase	1.75
	$11.78

a. What errors were made?

b. How much should Mrs. Dwyer have been charged?

7. Mr. Westover bought gasoline and oil at a service station in New York City, paying a 1% sales tax. He received a sales slip showing the following:

11.7 gal. gas at 25.1 cents	$3.27
2 qt. oil at 40 cents	.80
	$4.07
city sales tax	.41
	$4.48

Check the sales slip for errors. If you find any, make a new (correct) sales slip for the transaction.

8. Mrs. Rainey, who lives in a state charging a $2\frac{1}{2}\%$ sales tax, received a sales slip which read as follows:

$11\frac{1}{2}$ yd. tapestry at $3.79	$42.59
2 boxes upholstery nails at $.19	.38
	$42.97
sales tax	.86
	$43.83

Check the sales slip for errors. If you find any, make a new sales slip for the transaction.

9. Mr. Brainerd bought hardware for his front door and received a sales slip as follows:

1 cylinder front-door set	$ 9.95
3 house numbers at $.19	.77
1 numeral frame	.45
1 mail box	1.85
1 chain door guard	.39
	$15.08
2% tax	.31
	$15.39

Mr. Brainerd paid for his purchases with a $20 bill. In change he received 2 pennies, 1 nickel, 1 dime, 3 quarters, and a $5 bill.

a. List the errors that were made.

b. How much should Mr. Brainerd have been charged, including tax?

c. How much change should he have received?

10. Mrs. Bennett bought material for a dress and received a sales slip as follows:

4 yd. rayon crepe at $1.89	$ 8.76
3 yd. sequin trim at $1.09	3.27
3 yd. seam binding	.10
1 zipper	.23
1 pattern	.65
2 spools sewing silk at $.10	.20
	$12.98
2% tax	.26
	$13.24

Mrs. Bennett paid for her purchases with a $20 bill. In change she received 2 pennies, a $1 bill, a $2 bill, and a $5 bill.

a. List the errors that were made.

b. How much should Mrs. Bennett have been charged, including sales tax?

c. How much change should she have received?

Charge-Account Bills

Any person with a satisfactory credit rating (see page 198) may open a charge account at a store that offers this service.

Figure 6-3

THE HARPER COMPANY
400 Main St.
Pottersville
Michigan

Date: Sept. 1, 19–

Sold to: Mr. William Beck
2865 W. 48 St.
Pottersville, Mich.

Amount: $13.15

Bills are due and payable on or before the tenth day of the month following the purchase.

Date	Item	Charges			Credit	Pay last amo in this colu
		Cost	Sales tax	Federal tax		
Aug. 1	Balance forward					15.28
Aug. 6	Cash				15.28	
Aug. 14	1 sport shirt	2.75	.08			2.83
Aug. 21	1 dressing case	4.95	.15	.99		8.92
Aug. 24	2 pillows	1.94	.06			10.92
	2 playsuits	2.16	.07			13.15

When you have a charge account, you need not pay for your purchases at the time you make them; instead, you receive a bill for them later.

Figure 6–3 shows a monthly charge-account bill. Study it to find the following facts:

(1) The name and location of the store where the purchases were made.
(2) To whom the purchases were charged.
(3) On what date the bill is supposed to be paid.
(4) How much the purchaser owed on the first of the month for which the bill is issued.
(5) How much he paid during the month.
(6) What merchandise was bought during the month.
(7) On what dates the purchases were made.
(8) How much each purchase cost
(9) The tax on each article, if there is a tax.
(10) The total amount owed at the end of the month.

When the customer pays the store money, the amount is entered in the credit column and subtracted from the amount in the column farthest to the right. When the customer makes purchases, the cost of the articles and any taxes on them are added to the amount in the column farthest to the right. Thus, on August 21, the price of $4.95, the sales tax of $.15, and the Federal tax of $.99 were added to $2.83.

PROBLEMS

1. Mr. Beck owed the Harper Company $13.15 at the end of August. He paid this bill on September 5. During September Mrs. Beck charged the following purchases:

Sept. 10	1 box bath powder at $.39
	3 pairs men's socks at $.59 per pair
	1 pair child's sandals at $2.20
Sept. 15	1 dress at $16.95
Sept. 20	1 pair men's pajamas at $2.85

There was a sales tax of 3 per cent on each purchase and a Federal tax of 20 per cent on the powder. Prepare a statement such as the Harper Company sent Mr. Beck on October 1.

When a charge customer signs a sales slip he shows that he is accepting the charge as correct. All stores that have charge accounts take some precautions against their use by unauthorized persons.

GALLOWAY

2. On June 1, Mrs. Starrett of 1717 Tremont Street, Pottersville, Michigan, owed the Harper Company \$18.20. She paid her bill on June 4. During the month of June she charged the following purchases:

June 7	1 purse at \$5.75
	2 pair hose at \$1.15 per pair
June 15	1 pair gloves at \$1.75
	1 slip at \$2.39
June 19	1 lamp shade at \$2.85

There was a 3 per cent sales tax on each purchase, and a Federal tax of 20 per cent on the purse. Prepare a statement such as the Harper Company sent Mrs. Starrett on July 1.

3. Mrs. W. J. Bass of Clearview, Missouri, has a charge account at the Bazaar, a store in Arkansas City, Missouri. Her October bill totaled \$28.50. On November 8 she sent the store a check for \$25.00. On November 15 she charged 5 pairs of drapes at \$5.95 per pair, a hat at \$6.98, and 1 pair of shoes at \$9.15. She made no other purchases in November. Prepare a statement such as Mrs. Bass received from the Bazaar on December 1. Include a 2 per cent sales tax. None of the purchases was subject to a Federal tax.

4. Mr. Jacobs, who lives where he does not have to pay a sales tax, received the bill that follows. In checking it, he found two errors.

a. What were the errors?

b. What amount should Mr. Jacobs have been charged?

THE ARNOLD DEPARTMENT STORE
315 South 10 Street
Lincoln, Neb.

March 1, 19___

Sold to: Alfred Jacobs
3526 Jones St.
Lincoln, Neb.

Amount: $26.93

All accounts are due in full on or before the tenth day of the month following the purchase.

Date	Item	Charge	Credit	Pay last amount in this column
Feb. 1	Balance forward			25.18
4	Blanket	6.98		31.16
8	Automatic iron	10.95		42.11
9	Cash		25.18	16.03
15	Necklace	4.80*		20.83
25	Coffee maker	6.10		26.93

** Includes 20 per cent Federal tax.*

5. Mrs. Blake received the bill shown on the next page. The bill contained several errors.

a. List all the errors you can find.

b. Make out a correct bill for Mrs. Blake.

THE JEWETT-CHAMBERLIN COMPANY

1022 Redwood Road
Santa Maria, California

Sold to: Mrs. B. A. Blake
4505 Mars Avenue
Santa Maria, California

Date: April 1, 19__
Amount: $65.75

Bills due and payable on or before the tenth day of the month following purchase.

Date	Item	Cost	State sales tax—2½%	Federal tax—20%	Credit	Balance
Mar. 1	Balance forward					31.15
5	Cash				31.15	
8	Pullman case	28.74	.72	5.75		35.21
15	Housecoat	10.75	.27			45.24
	3 blouses at 2.25	4.75	.12			50.11
18	Perfume	4.25	.11	1.06		55.53
25	Shoes	9.95	.27			65.75

Bills for Household Utilities

Almost every family that lives in a town or city receives bills for electricity, gas, and water. The companies that provide these utilities keep track of the amount each household uses and charge accordingly. Each time you turn on a light or use an electric appliance, the amount of current used is measured by an electric meter. Each time you open a gas jet, the amount of gas used is registered on a gas meter. Each time you let water run, the amount is registered on a water meter. Company representatives read these meters regularly. Gas and electric meters are usually read monthly; water meters are usually read quarterly (every three months).

Bills for Electricity

Electricity is sold by the *kilowatt hour* (KWH). One kilowatt hour is equal to 1000 *watt hours*. When a 100-watt light bulb burns for one hour, 100 watt hours are used; when the same bulb burns for ten hours, 1000 watt hours (or 1 KWH) are used. When a 500-watt electric iron is used for one hour, 500 watt hours of electricity are used; when the same iron is used for two hours, 1 KWH is used. The electric meter shows the number of kilowatt hours used.

"We were never in this mess before I got that raise and we thought of all those different ways of spending it."

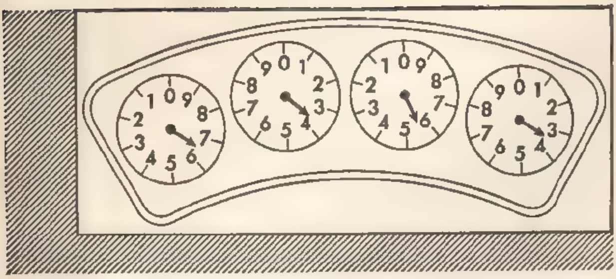


Figure 6–4

Figure 6–4 shows the dials of an electric meter (or a kilowatt-hour meter). The reading shown is 6353 KWH. When a hand is between two numbers, the smaller of the two numbers is read.

You can think of each dial as representing a certain place value. The dial farthest to the right represents the ones place; the dial next to it represents the tens place; the third dial from the right stands for the hundreds place; and the fourth dial from the right stands for the thousands place. Thus, in Figure 6–4:

Dial farthest to the right reads	3	KWH
Dial second from the right reads	50	
Dial third from the right reads	300	
Dial fourth from the right reads	6000	
	6353	KWH

Each hand moves one tenth as fast as the hand on the dial to the right of it. Thus, when the hand on the ones dial has gone around from 0 to 0, or through 10 divisions, the hand on the hundreds dial has moved through only one division. When the hand on the ones dial has made ten complete turns from 0 to 0, or through 100 divisions, the hand on the tens dial has made one complete turn from 0 to 0; it has gone through

Figure 6–5

THE CITIZENS' ELECTRIC ILLUMINATING COMPANY

320 BROAD STREET CERAMIC CITY, KY.

Mr. T. A. Corrigan
85 Northern Drive
Ceramic City, Ky.

Office Hours: Weekdays 8 A.M.
Saturdays 8 A.M.

LATEST METER READINGS KWH					AMOUNT
FROM		TO		TOTAL	
June 1	3165	July 1	3334	169	$4.90

This bill is payable on or before 7/15/—

10 divisions. Meanwhile, the hand on the hundreds dial has moved through only one division.

A bill for electricity shows the meter reading the previous month, the last reading, the difference between the two readings, and the amount the customer owes. One company sends a bill that looks like Figure 6–5, page 234.

According to this bill:

The meter reading July 1 was	3334 KWH
The meter reading June 1 was	3165 KWH
The number of KWH charged was	169
The amount of the bill was	$4.90

To find out whether or not a bill for electricity is correct, you must know the rate schedule of the company. It is usually shown on the back of the bill. The bill in Figure 6–5 was computed according to the following rate schedule:

First 35 KWH:	$.04 per KWH
Next 65 KWH:	.03 per KWH
Next 150 KWH:	.0225 per KWH
Additional KWH:	.015 per KWH

Example When Mr. Corrigan examined his bill for electricity, shown in Figure 6–5, he accepted the meter readings as correct. If they were, was the amount of the bill also correct?

What to Do	How to Do It
(1) Find the cost of the first 100 KWH.	35 × $.04 = $1.40 65 × .03 = 1.95
(2) Find the number of KWH charged at the third rate.	35 + 65 = 100 169 − 100 = 69
(3) Find the cost of the KWH charged at the third rate.	69 × $.0225 = $1.5525 = $1.55
(4) Find the total cost and compare it with the bill.	$1.40 + $1.95 + $1.55 = $4.90 The bill is correct. Answer

PROBLEMS

Each of these problems asks you whether or not a certain charge was correct. Show all the steps by which you arrive at your answers.

1. Mr. Collins received a bill for electricity totalling $7.10. The meter readings, which Mr. Collins believed to be correct, showed that he had used 275 KWH during the month. If he was charged according to the rate schedule on page 235, was the amount correct?

2. On December 2, Mr. Lawson's electric meter read 5824 KWH; on January 3 it read 5967 KWH. On January 10 Mr. Lawson received a bill covering the period between these two readings. It showed a charge of $4.32 for 143 KWH. If Mr. Lawson was charged according to the rate schedule on page 235, was his bill correct?

3. In a certain community the following rates are charged for electricity:

First 20 KWH	$.06 per KWH
Next 60 KWH	.05 per KWH
Next 700 KWH	.03 per KWH
Additional KWH	.02 per KWH

The readings of Mr. Long's electric meter in January and February were 4684 KWH and 4876 KWH, respectively. Was his bill of $8.20, based on these readings, correct?

4. The United Edison Company charges $.06 per KWH for the first 25 KWH per month, $.045 for the next 50 KWH, $.035 for the next 125 KWH, and $.025 for the next 700 KWH. The minimum monthly charge is $.75. Mr. Perry's March bill of $9.38 was based on readings of 1045 and 1295 KWH. Was it correct?

5. The Midlands Consolidated Electric Corporation charges $.05 per KWH for the first 20 KWH per month, $.04 per KWH for the next 80 KWH; $.025 for the next 300 KWH, and $.012 for the next 700 KWH. The minimum charge is $.65 per month. Mr. Walter received the bill shown on the next page. Assume that the meter readings were correct. Was the correct amount charged?

MIDLANDS CONSOLIDATED ELECTRIC CORPORATION

Collinsville, West Virginia

A. S. Walter
7 Elm Tree Road
Collinsville, W. Va.

Date	*Meter Reading*	
Feb. 10	3972	
Mar. 12	4355	
Total KWH	483	***Amount due:*** **$12.70**

This bill is payable on or before April 1, 19__

The Cost of Operating Electric Appliances

When a bill for electricity seems too large, many householders begin to check on the use of lights. Actually lights are the last thing to be concerned about. If you leave an electric bulb burning all night, the cost to you is only two or three cents. But if you leave an electric heater on all night, the cost is likely to be 40 or 50 cents. A heater uses more electric power — that is, more *watts* — than a light bulb.

To figure out how much it costs to operate an electric appliance, you must of course know the rate at which you pay for electricity. But you also need to know two other facts:

(1) the number of watts the appliance uses
(2) the number of hours the appliance is operated.

The product of these two numbers is the number of watt hours of electricity the appliance uses. Since 1000 watt hours equals 1 KWH, you can easily calculate the cost of operating the appliance.

But how do you find how many watts an appliance uses? The number is marked on some appliances, such as light bulbs. Others are marked to show the number of *amperes* they take

and the number of *volts* on which they operate. You can find the number of watts by multiplying the number of amperes by the number of volts. For example, if an iron takes 6 amperes and operates on 110-volt house current, it uses 6×110, or 660 watts.

Still other appliances, such as motors, are marked to show the number of horsepower they use. One horsepower (1 HP) is equal to 746 watts; so you can find the number of watts by multiplying the number of HP by 746.

Example

A motor rated at 1.5 HP was used for 15 hours. What was the cost at $.02 per KWH?

What to Do	How to Do It
(1) Find the number of watts.	$1.5 \times 746 = 1119.0$ watts
(2) Find the number of watt hours.	$1119 \times 15 = 16{,}785$ watt hours
(3) Find the number of KWH.	$16{,}785 \div 1000 = 16.785$ KWH
(4) Find the cost.	$16.785 \times \$.02 = \$.3357 = \$.34$ Answer

PROBLEMS

In solving these problems, first find the number of watts an appliance uses.

1. How much does it cost to burn five 40-watt bulbs for 10 hours, if the rate for electricity is $.04 per KWH?

2. What is the cost of using eight 60-watt bulbs for 5 hours, if electricity is charged at $.035 per KWH?

3. An electric hair dryer takes 5 amperes from a 110-volt circuit. What does it cost to use the dryer for 1½ hours if electricity costs $.05 per KWH?

4. An electric roaster takes 12 amperes from a 110-volt line. Find the cost of using the roaster for 3 hours when the electric rate is $.045 per KWH.

5. Mr. Barton has an electric pump to supply water for his house and for the stock on his farm. The pump operates on a 220-volt line and is rated at 12 amperes. How much does it cost him to operate it six hours per day for thirty days at \$.03 per KWH?

6. Mrs. Allman's electric fan operates on a 110-volt circuit and is rated at 1.2 amperes. If it is used 20 hours per week for four weeks, what is the cost at \$.0225 per KWH?

7. Mr. Conway has a $\frac{1}{2}$ HP motor which he uses on an average of six hours per day, five days per week. What is the cost of using it four weeks at \$.015 per KWH?

8. A washing machine is operated by a $\frac{1}{4}$ HP motor. How much does it cost to use it $3\frac{1}{2}$ hours per week for 52 weeks at \$.03 per KWH?

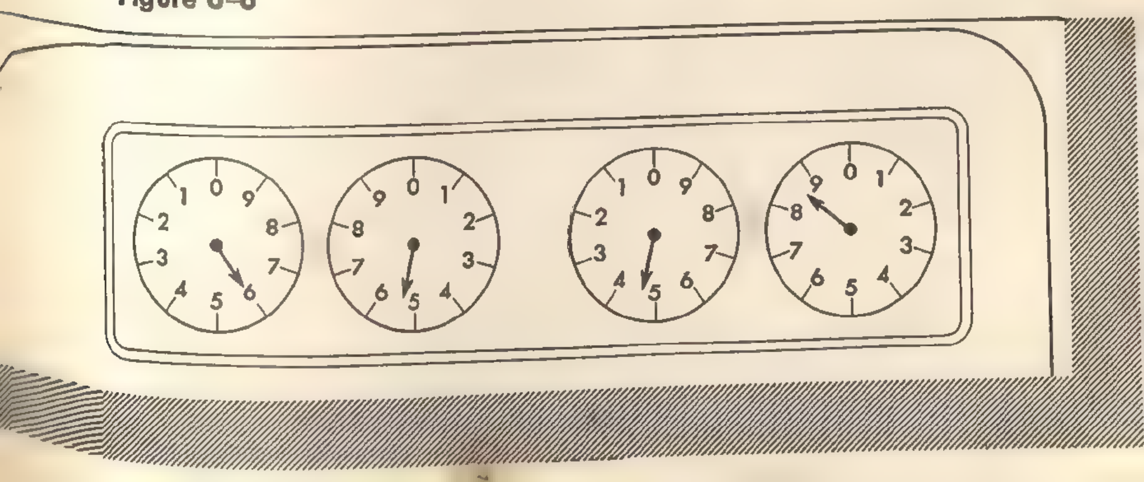
9. Heating appliances generally use more current than motor-driven appliances. A certain electric fan uses 60 watts and a toaster uses 350 watts. If electricity costs \$.04 per KWH, how much more does it cost to operate the toaster than it costs to operate the fan, if each is in use 15 hours?

10. Mrs. Wills has an electric mangle which uses 1600 watts. Her refrigerator uses 300 watts. How much greater is the cost of operating the mangle for ten hours than the refrigerator for the same length of time at \$.03 per KWH?

Bills for Gas

Gas bills tell how many cubic feet of gas were used during the period between meter readings. A gas meter looks very

Figure 6–6



much like an electric meter, and it is read in much the same way. The gas meter in Figure 6–6 reads 654,800 cubic feet.

The dials on a gas meter represent place values, but these are not the same place values as those represented by the dials on an electric meter. The dial farthest to the right in Figure 6–6 represents the hundreds place; the next dial, the thousands place; the next dial, the ten-thousands place; and the dial farthest to the left, the hundred-thousands place. Thus:

Dial farthest to the right reads	800 cu. ft.
Dial second from the right reads	4,000
Dial third from the right reads	50,000
Dial fourth from the right reads	600,000
	654,800 cu. ft.

In reporting the reading of the meter shown in Figure 6–6, the zeros in the tens and hundreds places are ordinarily ignored. The reading is shown either as 6548 hundred cubic feet or as 654.8 thousand cubic feet. "Thousand cubic feet" is usually abbreviated MCF.

Figure 6–7 shows a sample gas bill. According to this bill, the meter reading on February 5 was 125.7 MCF, and on March 5 it was 134.1 MCF. During the month, 8.4 MCF of gas were used; that is, 8400 cubic feet. Two different charges

Figure 6-7

THE LAMBERT CITY GAS COMPANY
HARZ BUILDING LAMBERT CITY, ILL.

A. L. West
90 Fredonia
Lambert City, Ill.

Office Hours:
Weekdays 8:30
Saturdays 8:30

METER READINGS		CONSUMED	AMOUNT	
Feb. 5	Mar. 5	M. C. F.	Gross	Net
125.7	134.1	8.4	5.22	4.97
		TOTAL	5.22	4.97

Last Net Payment Date
Thursday, March 23, 19__

are given: one, called the *gross*, is \$5.22; the other, called the *net*, is \$4.97. The bill states that the last net payment date is Thursday, March 23. If the customer pays his bill on or before that date, he is charged only \$4.97; if he pays it after March 23, he is charged \$5.22.

Rates for gas, like other rates, are different in different places. The bill in Figure 6–7 was based on the following rate schedule:

First 1000 cu. ft.	\$.90
All gas over 1000 cu. ft.	\$.055 per 100 cu. ft.
Minimum charge	\$.90

An additional charge of \$.03 per 1000 cu. ft., if the bill is not paid when due.

Example In verifying the bill shown in Figure 6–7, Mr. West accepted the meter readings as correct. Were the net and gross charges correct, according to the rate schedule by which the bill was computed?

What to Do	How to Do It
(1) Find how much gas was charged at each rate.	8.4 MCF, total amount used 1 MCF, amount charged at \$.90 per 1000 cu. ft. 7.4 MCF, amount charged at \$.055 per 100 cu. ft.
(2) Find the total net charge.	7.4 MCF = 74 hundred cu. ft. 74 × \$.055 = \$4.070 1 × .90 = .90 \$4.97, total net charge
(3) Find the penalty charge.	8.4 × \$.03 = \$.252 = \$.25
(4) Find the total gross charge.	\$4.97 + \$.25 = \$5.22, total gross charge
(5) Compare the charges with those on the bill.	The bill is correct. Answer

GALLOWAY

A gas oven of this size usually consumes about 10 cubic feet of gas an hour. Of course, the amount varies with the temperature at which the oven is maintained.

PROBLEMS

Show all your computations for each of these problems.

1. Mr. Hayes is charged for gas according to the schedule on page 241. His gas bill for February showed that he had used 9.5 MCF of gas. Mr. Hayes believed that he had used that amount of gas, but he did not think that the charges shown on the bill were correct. The charges shown were $13.68 net and $16.53 gross. Were they correct?

2. On April 9 Mr. Rutherford's gas meter read 386.2 MCF; on May 9 it read 389.2 MCF. On May 15 Mr. Rutherford received a bill covering the period between these two readings. It showed a net charge of $2.00 for 3 MCF and a gross charge of $2.12. If Mr. Rutherford was charged according to the rate schedule shown on page 241, was his bill correct?

3. When Mr. Watson received his gas bill on July 15, it showed the following readings:

June 10	386.5 MCF
July 10	391.4 MCF

The net charge was $5.43, and the gross charge was $5.59. Mr. Watson pays for gas according to the following schedule:

First 500 cu. ft.	$.87
Next 2000 cu. ft.	.12 per hundred cu. ft.
All over 2500 cu. ft.	.09 per hundred cu. ft.

If the bill is not paid within ten days, a penalty charge of 3% is added. Were the net and gross amounts of Mr. Watson's bill correct? (Assume that the meter readings were accurate.)

4. Mr. Rose is charged for gas according to the following schedule:

First 100 cu. ft.	$.51
Next 1400 cu. ft.	.13 per hundred cu. ft.
Next 1500 cu. ft.	.12 per hundred cu. ft.
Over 3000 cu. ft.	.10 per hundred cu. ft.

The company gives a discount of $.01 per hundred cubic feet if the bill is paid within ten days. On February 10 Mr. Rose received a bill based on meter readings of 5824 and 5857 hundred cubic feet. The gross charge shown was $4.53.

a. Was the bill correct?

b. How much discount did Mr. Rose receive if he paid the bill on February 15?

5. Mr. Robinson's gas bill was received on February 15. The meter readings, which were reported in hundreds of cubic feet, were given as 1028 and 982. The gross bill was for $5.56. The rates were as follows:

First 100 cu. ft.	$.50
Next 1400 cu. ft.	.13 per hundred cu. ft.
Next 1500 cu. ft.	.12 per hundred cu. ft.
Next 6500 cu. ft.	.09 per hundred cu. ft.
Over 9500 cu. ft.	.06 per hundred cu. ft.

For payment before February 25, a discount of $.01 per hundred cubic feet was given.

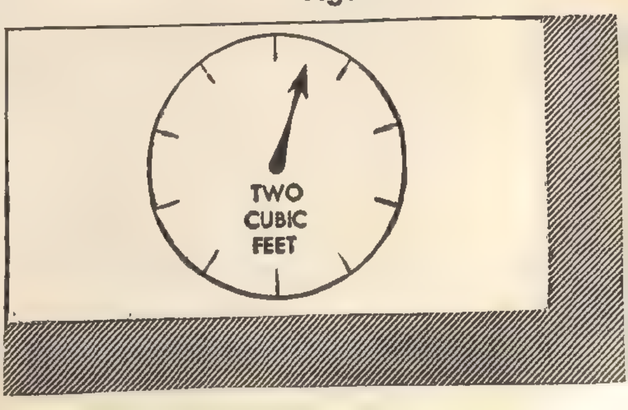
a. Was Mr. Robinson's gross bill correct?

b. How much did Mr. Robinson pay when he settled this bill on February 19?

The Cost of Operating Gas Appliances

In addition to the four large dials on the gas meter, there is a small dial that you can use to determine how much it costs to operate any gas appliance. The hand on this dial makes one complete turn whenever 2 cubic feet of gas are used. The dial has ten divisions; so each division represents .2 cubic foot. (See Figure 6–8.)

Figure 6–8



Example

Mr. Turner's gas hot-water heater operated continually. When no other gas appliance was in use, the gas meter registered 2 cu. ft. in 40 minutes. If Mr. Turner paid \$.14 per hundred cu. ft. of gas, how much did he spend per day to heat water?

What to Do	How to Do It
(1) Find the number of cu. ft. of gas used per minute.	2 cu. ft. ÷ 40 = .05 cu. ft.
(2) Find the number of cu. ft. of gas used daily.	60 min. = 1 hr. 24 hr. = 1 day .05 × 60 × 24 = 72 cu. ft.
(3) Find the cost of the gas used each day.	72 cu. ft. = .72 hundred cu. ft. .72 × \$.14 = \$.1008 = \$.10 Answer

PROBLEMS

1. Mrs. Steele uses her gas oven an average of 2 hours daily. While the oven is on, it consumes 2 cu. ft. of gas every 13 minutes. Mrs. Steele pays \$.11 per hundred cu. ft. for gas. What does she pay per week for the fuel for her oven?

2. While Mrs. Wolfe is canning, her gas stove consumes 2 cu. ft. of fuel every 8 minutes. She used her stove in this way for 9 days, averaging 3 hours per day. What did the fuel for canning cost her, if the gas was charged at \$.12 per hundred cu. ft.?

3. Mr. Clarke found that his gas furnace used 2 cu. ft. of gas in four minutes. He estimated that during the month of January it burned one half the time. What did the gas for the furnace cost during January at \$.055 per hundred cu. ft.?

4. The Richards family used their radiant gas heater on an average of 2 hours per day during February. When it was the only gas appliance in use, the hand on the small dial of the gas meter moved 1 division each minute. If Mr. Richards

paid $.09 per hundred cu. ft. of gas, what was the cost of operating the heater in February?

5. Mrs. Harris uses a double burner to heat water for washing clothes. When the burner is the only gas appliance in use, the hand on the small dial of the gas meter moves 2 divisions in 3 minutes. Gas costs the Harrises $.115 per hundred cu. ft. What is the cost of the fuel used to heat water for washing each month, if the double burner is needed on an average of $1\frac{1}{2}$ hours each week? ($4\frac{1}{3}$ weeks = 1 month)

Bills for Water

The water meter shows the number of cubic feet of water used. It is read in the same way as other meters. The water meter in Figure 6–9 shows a reading of 47,523 cubic feet, thus:

Lower dial at the right reads	3 cu. ft.
Upper dial at the right reads	20
Dial at top of the meter reads	500
Upper dial at the left reads	7,000
Lower dial at the left reads	40,000
	47,523 cu. ft.

Because water companies usually pay no attention to amounts less than 100 cubic feet, this reading would be reported as 47,500 cubic feet.

You can tell how much water is being used when a tap is open by watching the meter dial marked "one cu. ft." The hand on this dial makes one complete revolution when 1 cubic foot of water is used. One cubic foot of water is approximately 7.5 gallons. The dial is divided into ten parts; so each division measures .1 cubic foot or .75 gallon (three quarts).

Figure 6–9

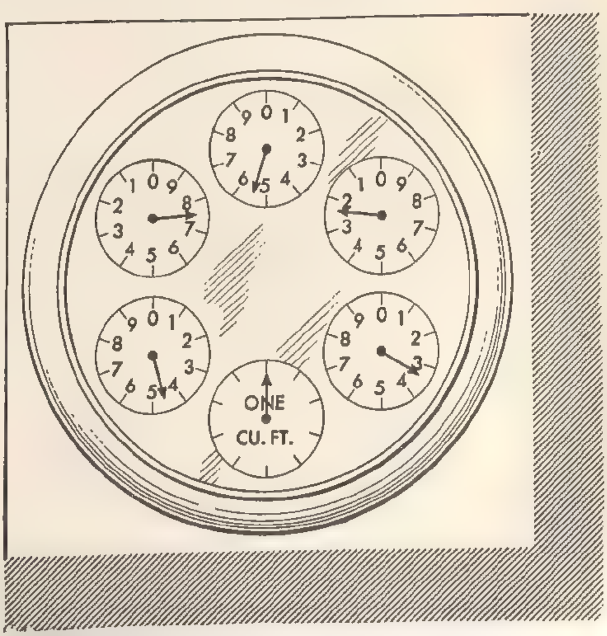


Figure 6–10 shows a typical bill for water. According to this bill, the water meter in Mr. Stein's house read 87,700 cubic feet on January 8, and 90,400 cubic feet on April 8. Mr. Stein was charged for 1000 cubic feet at $1.00 and for 1700 cubic feet at $.95 per thousand cubic feet. His total bill was $2.62, and the penalty charge for late payment was $.26.

PROBLEMS

Since each of the following problems is different from the others, be sure to find out what each problem asks you to do.

1. Assume that the meter readings shown in Figure 6-10 are correct. Show the calculations that must be made in order to find out whether the amount charged and the penalty charge are also correct.

2. During last summer Mr. Morgan used his lawn sprinkler an average of 3 hours a day 4 days each week for 12 weeks. When the sprinkler was operating, .8 cu. ft. of water was used in one minute. If Mr. Morgan pays for water at the rate of $.14 per hundred cu. ft., how much did it cost him to water his lawns during the summer?

Figure 6-10

CLAYTON CITY WATER DEPARTMENT

Courthouse Square — Clayton City, Ala.

Mr. J. P. Stein
215 Cherokee Road
Clayton City, Alabama

Office Hours 8 A.M.
Saturdays 8 A.M.

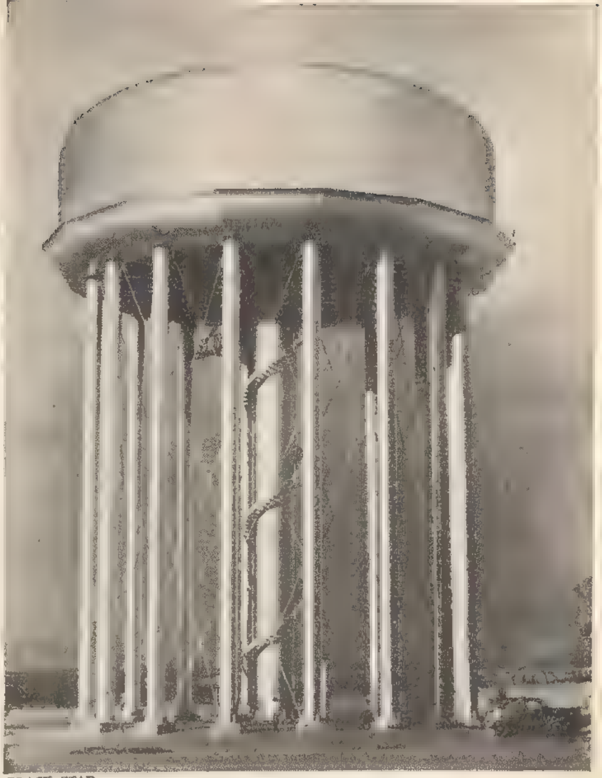
This Bill is due May 1, 19__		RATES
DATE	READINGS	Minimum charge $1.00 each quarter or less for first 1,000 cu. ft. or less. All water in excess of the first 1,000 cu. ft. at 95c per 1,000 cu. ft.
4/8	90400	
1/8	87700	
	2700 cubic feet	$2.62

10% penalty amounting to $.26 must be added to the water bill if not paid on or before May 15. Water will be shut off if NOT PAID in 30 days from above date.

Misc.
Credit $2.6
Total

3. The Union-Essex Water Company charges $1.50 for the first thousand cubic feet of water used each quarter, and $.13 per hundred cubic feet for all water in excess of 1000 cu. ft. Find the water bill when the amount of water used in three months is as follows:

a. 1600 cu. ft.
b. 3200 cu. ft.
c. 1100 cu. ft.
d. 5300 cu. ft.
e. 7500 cu. ft.



BLACK STAR

This tower, in Tucson, Arizona, holds the water that will be sent through pipes to the homes in the city.

4. Mr. Owens' quarterly water bill showed that the reading of the meter was 43,200 on February 5 and 47,100 on May 8. The minimum charge is $1.50 for the first thousand cubic feet or less, and all water in excess of 1000 cu. ft. is charged at $.12 per 100 cu. ft. A penalty charge of 10% is added to the bill if it is not paid in 15 days. Mr. Owens was billed for $6.18, with a penalty charge of $.62. Verify his bill, assuming that the meter readings were reported correctly.

5. The rate schedule of the Mindowaskin Water Company is as follows:

First 1000 cu. ft.	$1.20
Next 9000 cu. ft.	.11 per 100 cu. ft.
Next 90,000 cu. ft.	.09 per 100 cu. ft.
Over 100,000 cu. ft.	.07 per 100 cu. ft.

The company sends its bills quarterly, and adds a penalty charge of 10% if bills are not paid within ten days.

The Jacksons live in a town served by the Mindowaskin Water Company. Five successive readings of their meter are reported on the next page.

January 8	29,400
April 8	32,700
July 10	38,100
October 12	47,200
January 4	49,100

a. What were the net amounts of the bills sent Mr. Jackson on April 15, July 15, October 15, and January 15?

b. If Mr. Jackson always paid his water bills within ten days after receiving them, how much money did he save in this way during the year?

Bills for Telephone Service

Telephone bills are sent monthly. The cost of telephone service depends on where you live, what type of service you have, and what calls you make. It does not depend on the number of calls you receive.

In most localities, three grades of telephone service are available: one-party (private line), two-party, and four-party. Usually it is also possible to choose between "measured service" and "unlimited service." When you have measured service, you are allowed a certain number of local messages each month and pay extra for additional calls. A local call that lasts longer than a prescribed length of time (usually either five minutes or three minutes) counts as two calls instead of one. When you have unlimited service, you may make as many local calls as you wish without extra charge; but, of course, the basic rate for unlimited service is higher than that for measured service.

Your telephone can be connected with any other telephone in the country and with telephones in many foreign countries. There are two kinds of long-distance calls: station-to-station and person-to-person. When you make a person-to-person call, you are connected with a particular individual whom you name; when you make a station-to-station call, you are connected with a particular telephone. and run' the risk that the person you want may not be at home. Naturally, the person-to-person call is the more expensive. Rates for both kinds

of long-distance calls are lower at night, on Sundays, and on some holidays than they are during business hours. All telephone service is taxed by the Federal government.

A telephone bill shows (1) the monthly charge for the kind of service you have, plus Federal tax; (2) additional charges for extra calls on measured service, plus tax; and (3) out-of-town or toll charges, including tax. When there are toll charges, the bill is accompanied by an itemized list. This list shows the date on which each out-of-town call was made, what place was called, and the charge. "Collect" calls, made from out-of-town points with the permission of the person receiving the message, are marked "FM," short for "from." Telephoned telegrams are also included. The list shows the Federal tax on these calls. Many people keep their own record of out-of-town calls, so that they can check the calls charged to them.

PROBLEMS

Add a 10 per cent Federal tax to all charges. Show all the computations by which you arrive at the answers to these problems.

1. Miss Scott, who lives in a small town, pays \$2.50 a month for unlimited telephone service. Her bill on May 15 was for \$3.54. She had made one long-distance call, for which she was charged \$.72. Was her bill correct?

2. Mr. Platz has a single-party line with unlimited service, for which the telephone company charges him \$5.00 per month. One month he made three calls to nearby towns, costing \$.10, \$.15, and \$.25. He also made a long-distance call for which he was charged \$2.20. Find his total bill.

3. Mr. Stirrup's telephone bill for June was \$7.01. He has a two-party line with measured service, for which the charge (exclusive of tax) is \$3.00 a month. He is allowed 45 local messages each month, and is charged \$.035 for each additional local call. During June he made 50 local calls, and four out-of-town calls. The charges on the out-of-town calls were \$.25, \$.95, \$1.70, and \$.30. Was his bill correct?

4. The Atkinsons have single-party unlimited service, for which the basic rate is \$5.25. They make frequent calls to

This central switchboard handles telephone calls sent from cities in America to telephones in London, England.

nearby towns, paying $.20 for each call to Winfield or Fieldston, $.10 for each call to Black River, and $.15 for each call to Westaway. During February they called Winfield four times, Westaway five times, Black River five times, and Fieldston twice. They also called Cincinnati at a cost of $.95, Detroit at a cost of $1.70, and Louisville at a cost of $.95. The total bill was $12.43. Verify this bill.

5. Mr. Brooks, who lives in Cleveland, pays $3.25 a month (plus tax) for 60-message measured service. Additional local messages are charged at $.0425 each. In April Mr. Brooks made 93 local calls, a week-day station-to-station call to Los Angeles that lasted for 3 minutes, and a Sunday person-to-person call to Miami, Florida, that also lasted for 3 minutes. The day station-to-station rate for three-minute calls between Cleveland and Los Angeles is $2.35; the Sunday person-to-person rate for three-minute calls between Cleveland and Miami is $2.20. Mr. Brooks' April bill totaled $9.65. Was it correct?

What You Have Learned in This Chapter

1. To verify sales slips and charge-account bills
2. To prepare sales slips and write receipts
3. To count change as cashiers do
4. To read meters — electric, gas, and water
5. To verify bills for electricity, gas, and water
6. To calculate the cost of using various electric and gas appliances
7. To use the term *kilowatt hour* (KWH) in connection with bills for electricity
8. To verify telephone bills

Review Test on Household Bills

1. Mr. Edwards bought a faucet spray for $.22; a car door mirror for $.61; and a tire pump for $2.25.

a. How would the clerk count his change from a ten-dollar bill?

b. How much change should he receive?

c. What coins and bills should he receive?

2. Yesterday Mrs. W. J. Hicks of 719 20th Street, Greeley, Colorado, purchased the following articles at the Silk and Cotton Shop:

1 hem marker $1.89
3 packages bias tape at $.10 each
12 yards Val lace at $.27 a yard
1 package mending tape $.20

There was a 2 per cent sales tax. Mrs. Hicks gave the clerk a $10 bill in payment. Make a sales slip for Mrs. Hicks.

3. Mr. Hendrickson, who lives in a state that has no sales tax, found that two errors in arithmetic had been made in a charge-account bill he recently received. Part of the bill is shown on the next page.

Date	*Item*	*Charges*	*Credits*	*Balance*
June 1	Balance	$42.53		$42.53
June 8	1 raincoat	14.90		57.43
	1 set oil paints	8.50		65.93
June 10			$42.53	21.40
June 16	1 cowboy record album	3.94		25.34
	1 box airmail stationery	1.19		26.53
	1 manicure set	4.49		31.92
June 21	1 linen fishing line	1.69		33.61
	1 tackle box	4.79		38.30

a. What were the errors?

b. What should have been the amount of Mr. Hendrickson's bill?

4. The Midlothian Electric Light and Power Company charges $.06 per KWH for the first 35 KWH used each month, $.05 per KWH for the next 65 KWH, $.035 for the next 200 KWH, and $.025 for the next 700 KWH. A bill showed the meter readings as follows:

September 10, 6132 KWH; October 10, 6620 KWH.

The amount charged was $17.10. If the meter readings were correct, was the charge also correct? Show the computations by which you arrive at your answer.

5. One month Mr. Tracy used a soldering iron ten hours. The iron takes 6 amperes from a 120-volt circuit. What is the cost of operating it at $.0225 per KWH?

6. Mr. Hurlbert's gas bill is computed according to the following schedule:

First 100 cu. ft.	$.47
Next 1400 cu. ft.	.12 per 100 cu. ft.
Next 1500 cu. ft.	.11 per 100 cu. ft.
Over 3000 cu. ft.	.10 per 100 cu. ft.

The company makes a penalty charge of 10 per cent on bills unpaid in 15 days. On February 10 Mr. Hurlbert received a bill based on meter readings of 5824 and 5867 hundred cubic feet. The net and gross amounts charged were $5.20 and $5.72. Were the charges correct? Show the computations by which you arrive at your answer.

7. Mr. Kennedy's gas hot-water heater is in operation on an average of seven hours daily. When no other gas appliance is in use, the 2 cubic foot dial on the meter makes one complete turn in 30 minutes. At \$.125 per hundred cubic feet, what is the weekly cost of gas for the heater?

8. The Somerset Water Supply Company charges \$.15 per hundred cubic feet regardless of the amount of water used. If bills are paid within 15 days, a deduction of \$.01 per hundred cu. ft. is made. Mr. Berry received his bills on March 20, June 20, October 20, and December 20. He paid them on March 25, June 23, October 30, and January 10. The bills were based on the following meter readings:

December 10	30,653
March 12	33,216
June 7	35,432
October 9	40,021
December 11	42,139

a. What was the total gross amount of Mr. Berry's water bill for one year?

b. How much discount was Mr. Berry allowed in all for prompt payment?

9. Mrs. Hammond's two laundry tubs are used twice weekly. While one tub is being filled, the water meter shows that 2.4 cu. ft. of water are used. If Mrs. Hammond pays \$.13 per hundred cubic feet for water, how much does water for laundry cost her in a year?

10. Mr. Kraft has measured telephone service, costing him \$3.50 monthly, plus 10% tax. Local calls in excess of fifty cost \$.035 each, plus 10% tax. In April, 63 local calls were charged to Mr. Kraft. He made a long-distance call to Washington, D.C. at the lowest possible rate, which cost him \$1.65, plus 10% tax. The total amount of his bill was \$6.17. Was the bill correct? Show your calculations.

How do you rate?	Excellent	Good	Fair	Poor
	10	8–9	6–7	5 or less

HAPTE 7

BLACK STAR

1. Find out exactly what you would have to do to open a regular checking account in a local bank. Find out how you would go about opening a special checking account.
2. Find out what the service charges are for a checking account in a bank near your home.
3. Examine the checks and deposit slips used by a local bank. If possible, study a bank statement sent out by a local bank.
4. Examine a cancelled check that has been endorsed several times. Discover what its travels were from the time it was written until it was returned to the person who wrote it.
5. Get money-order forms from your post office and express agency. Fill them out as if you were actually sending money to someone.

CHECKS AND MONEY ORDERS

HAVE YOU EVER had to send money to someone living at a distance? Have you ever had to carry a large sum of money — say $100 or $200 — from one city to another? Whether or not you have had these experiences, you know that it is foolish to take unnecessary risks of losing money and of having it stolen. There are ways of avoiding such risks.

Using a Checking Account

When you have a checking account, you can often use a check instead of currency. A checking account is safe and convenient. Furthermore, it provides an efficient way of keeping account of expenditures.

Putting Money in a Checking Account

When you open a checking account, the bank requires you to sign a card similar to the one shown on the next page (Figure 7–1). Your signature on this card is a protection against forgery; if anyone else should sign your name on a check, the difference in writing will be detected, and the bank will not pay the check.

The signature card shown in Figure 7–1 was prepared for Ted Brower, whose full name is Theodore David Brower. He wrote Theodore D. Brower on the signature card; consequently, he must sign all his checks Theodore D. Brower. If he should sign either his nickname or his full name, the bank would not honor the check.

Of course, you must deposit money to open a checking account. To do so, you fill in a *deposit slip* like the one in Figure 7–2, and hand the money and the deposit slip to the bank teller. The teller writes the amount in a *passbook*, which he gives you, together with your *checkbook*. You are now equipped to write checks.

From time to time, you will deposit more money in your checking account. Whenever you do so, you fill out a deposit slip. The bank teller notes the amount in your passbook, and you note the amount in your checkbook.

When you deposit money in the form of checks (for example, when you deposit a pay check), you should identify each check. You can do so by writing on your deposit slip the name of the bank on which the check is drawn. Or you can write the number of the bank, for every bank in the nation has its own number. In Figure 7–2, checks are identified by number. This number is printed on each check, just as the name of the bank is. (See Figure 7–3, page 259.)

Figure 7-1

TITLE OF ACCOUNT (PLEASE TYPE) Brower, Theodore D.
79 Washington St., Talmo, Kansas

IN ACCOUNT WITH **GRAIN EXCHANGE TRUST COMPANY** **TALMO, KANSAS**

YOU ARE AUTHORIZED TO MAIL OR TO DELIVER BY MESSENGER TO OUR ADDRESS EACH MONTH, STATEMENT OF CHECKING ACCOUNT AND CANCELLED VOUCHERS.

NAME (TO BE TYPED)	TITLE	AUTHORIZED SIGNATURE(S)
Theodore D. Brower		Theodore D. Brower

SECRETARY OR OTHER RECORDING OFFICER WILL PLEASE ATTEST ABOVE SIGNATURE(S) HERE. → ______ DATE Gunnar Carlsen, Secy.

PROBLEMS

In each case, identify the banks on which checks were drawn by writing their names. Use copies of the forms in Figures 7–1 and 7–2, or copies of forms used by a local bank.

1. Hazel Judd, who works for the A. A. Dutton Company in Cranwood, Indiana, decides to open a checking account at the First National Bank of Cranwood. She has lived in the town all her life, and is well known to Mr. V. W. Young, the bank's treasurer. Prepare a signature card such as Hazel signed. Use today's date.

2. Henry Dickinson is employed by the General Supply Company of Masefield, Minnesota. He lives at 290 White Bear Street in Masefield. He opened a checking account at the Masefield Bank and Trust Company by depositing $75.00 in cash and a check for $191.10 drawn on the Merchants' Trust Company of St. Paul, Minnesota. He was identified by William Whittaker. Prepare Mr. Dickinson's signature card and deposit slip. Use today's date.

3. Charles F. Adamson, of 13,400 Hall Avenue, Pittsburgh, Pennsylvania, has a checking account at the West Liberty Bank of Pittsburgh. On May 3 he deposited the following checks: Steelmen's Bank of Youngs-

Figure 7–2

DEPOSITED IN

GRAIN EXCHANGE TRUST COMPANY
TALMO, KANSAS

In receiving items for deposit or collection GRAIN EXCHANGE TRUST CO obligates itself only as the customer's collecting agent, assuming no responsibility beyond the exercise of due care, crediting all items subject to final payment in cash or solvent credits. At any time before final payment, GRAIN EXCHANGE TRUST CO. reserves the right to charge back to the customer's account the amount of any item previously credited, whether returned or not, and even though drawn on itself. It is understood that GRAIN EXCHANGE TRUST CO. or any of its correspondents, may send items, directly or indirectly, to any Federal Reserve Bank, or to any other bank including the payor, for collection subject to all conditions from time to time imposed by such bank and may accept the drafts or credits of any such banks including the payor as conditional payment in lieu of cash, and shall not be responsible for the default or negligence of such banks or their sub-agents, or for losses in transit, or otherwise in the course of collection, but only for its own acts

	DOLLARS	CENTS
COIN	3	20
BILLS	15	
COUPONS (Only one issue and maturity to be enclosed in each envelope)		
CHECKS 5-39/110 1	13	39
55-281/212 2	2	43
3		
4		
5		
6		
7		
8		
9		
10		
TOTAL	34	02

FOR ACCOUNT OF

Theodore D. Brower

October 27 19—

PLEASE ENDORSE ALL CHECKS

LAMBERT

Most banks require a depositor to make out a deposit slip each time he puts money in his account.

town, Ohio, \$45.20; Iron Rose Bank of Doylesville, Pennsylvania, \$25.80 and \$45.15; and Allegheny National Bank of Meadtown, Pennsylvania, \$254.58. Prepare Mr. Adams' deposit slip.

4. Howard Biddle, of 7120 East 85th Street, St. Louis, Missouri, has a checking account in the Central Bank of St. Louis. On August 15 he deposited the following checks: Bank of Manhattan, Kansas, \$125.20; Central Bank of St. Louis, \$17.80 and \$85.17; and Midwood Bank, Brooklyn, New York, \$217.00. Prepare Mr. Biddle's deposit slip.

5. H. C. Barrett of 75 East Elm Street, Middletown, Ohio, deposited the following currency in the Second National Bank of Middletown on January 20:

23 pennies	13 dollar bills
16 nickels	1 two-dollar bill
33 dimes	7 five-dollar bills
24 quarters	2 ten-dollar bills
11 half dollars	1 twenty-dollar bill

At the same time he deposited checks for \$7.50 and \$15.28 drawn on the Second National Bank of Middletown and a check for \$20.72 drawn on the First National Bank of Middletown. Prepare Mr. Barrett's deposit slip.

Writing Checks

Your checkbook contains a number of blank checks. Each check is accompanied by a *stub*. The stub is your record of the check. It also provides a place for recording the amount of money you have in the bank. You should always fill in the check stub before you write the check itself. After you

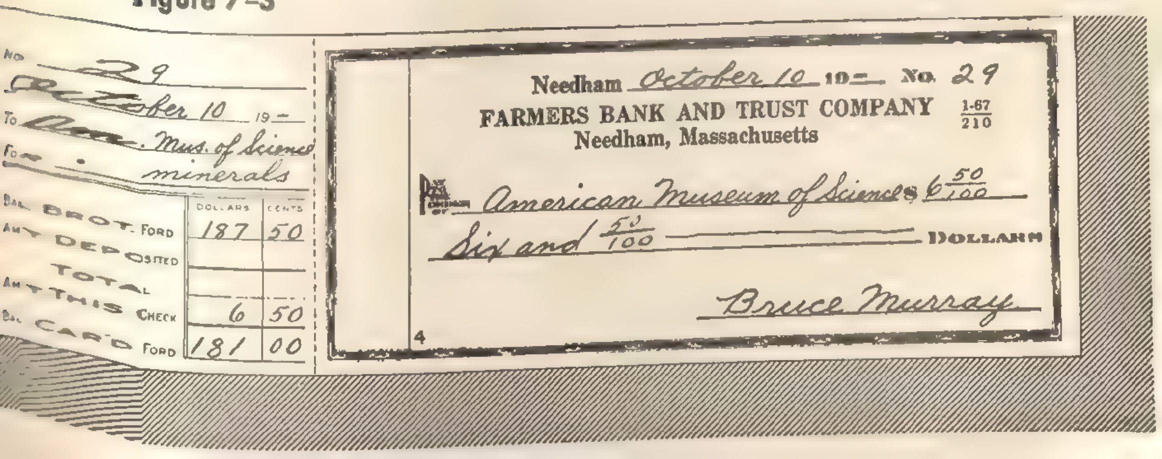
have written a check, you detach it from the book, but the stub remains.

There are certain precautions to be observed in writing checks:

(1) Always use ink.
(2) Begin at the left of every line.
(3) Write clearly and without flourishes, for fancy handwriting is easy to forge.
(4) Write the amount for which the check is drawn in dollars and hundredths of a dollar; for example, $\$4\frac{20}{100}$ and "Four and $\frac{20}{100}$ dollars," not \$4.20.
(5) If the space preceding the word "dollars" is more than you need, draw a line through the space you do not use.
(6) Be sure that the amount of the check agrees in words and figures.
(7) Be sure that you have enough money in your checking account to pay the amount of the check.
(8) Never sign a check until every line except the signature line has been filled. Be sure to sign your name just as it is on your signature card.
(9) If you make a mistake in writing the check, destroy the check and mark the stub "Void."

Here is an example. Bruce Murray has a checking account in the Farmers Bank and Trust Company of Needham, Massachusetts, on which he has already drawn 28 checks. His balance today is \$187.50. He draws a check to the American Museum of Science to send with an order for some mineral specimens. His stub and check look like Figure 7–3.

Figure 7–3



No. 29
October 10 19—
To Am. Mus. of Science
For minerals

	Dollars	Cents
Bal. Bro't. Ford	187	50
Am't Deposited		
Total		
Am't This Check	6	50
Bal. Car'd Ford	181	00

Needham October 10 19— No. 29
FARMERS BANK AND TRUST COMPANY $\frac{1-67}{210}$
Needham, Massachusetts

Pay to the order of American Museum of Science $\$6\frac{50}{100}$
Six and $\frac{50}{100}$ ——— Dollars

Bruce Murray

4

PROBLEMS

In writing the checks called for, use either the form of the check and stub in Figure 7–3 or the form of a check and stub from a bank in your community. Observe all the precautions mentioned on page 259.

1. F. R. Hunter had a balance in his checking account on March 11 of $175.20. On that date he wrote check number 17 for $21.75 to James Stevens for furnace repairs. Show his completed stub and check.

2. James Hill had a balance in his checking account on July 1 of $328.41. On that date he paid his insurance premium of $75.18, making his check payable to the Midwest Mutual Insurance Company. Show his completed stub and check.

3. On May 1 Harold Montgomery had a balance of $128.17. On that day he deposited $102.50 and wrote a check for $28.73 to Brown Brothers Servicenter for the gasoline and oil he had used during April. Show the completed stub and check.

4. Francis Brown had a balance in his checking account on April 10 of $147.50. On that date he made a deposit of $45.80 and wrote check number 25 to Harry W. Holmes for $40.50 for a suit of clothes. Show the completed stub and check.

5. Emil Cromwell had a balance of $215.35 in his checking account on April 1. During the month he wrote checks and made deposits as follows:

April	5	To Henry C. Young, D.D.S. . .	$ 15.00
	10	To Paul Frank, haberdasher . .	30.45
	20	To Consolidated Gas Company .	3.85
	21	Deposited	215.38
	21	To Georgia Telephone Company	4.25
	25	Withdrew cash	35.00
	30	To Ely Apartment Management	57.50

Find his balance on May 1.

Endorsing Checks

When you receive a check made out to you, you must *endorse* it before you can cash it, deposit it, or use it as cash.

There are three kinds of endorsements: endorsement in blank, endorsement in full, and restricted endorsement. These are shown in Figure 7–4.

(1) To endorse a check *in blank*, turn it over and write your name across the stub end, just as it appears on the face of the check. Now you can cash the check. So can anyone else by signing his name beneath yours. You should endorse a check in blank only when you are about to use it.

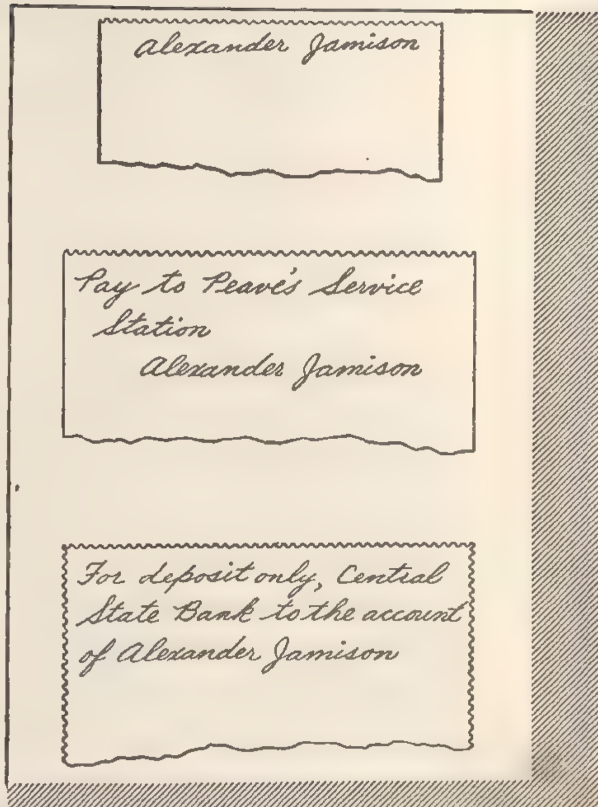


Figure 7–4

(2) To endorse a check *in full* means to make it payable to a certain person. If you wanted Ernest Emerson to cash a check made out to you, you would write on the back of the check, across the stub end, "Pay to Ernest Emerson" and sign your name. Until Ernest Emerson signs the check, no one else can cash it. (Some persons write "Pay to the order of . . ." instead of "Pay to . . ." This form is just as good.)

(3) A *restricted* endorsement is used when you want to deposit a check. Then you write, "For deposit only" and add the name of your bank and the words "to the account of" before you sign your name.

When you endorse a check, you accept the responsibility for it. Therefore you are justified in refusing to accept a check drawn by someone whom you do not know. Similarly, another person is justified in refusing your check if he does not know you.

PROBLEMS

Do not be misled by the fact that some of these problems contain more information than you need to use.

1. James C. Hunt wrote a check for $17.21 payable to William P. Clark. Mr. Clark endorsed it to Anna E. McCarty. Show the endorsement.

2. Stewart Henderson cashed a check for $7.35, signing it at the bank teller's window. Show the endorsement.

3. Assume that you have been paid $20 by means of a check signed by Clara E. Dickenson and wish to deposit it in your savings account. Write a restricted endorsement of the check.

4. Assume that you were given a check for $18.75, which you wish to use to buy a United States Savings Bond. Show how to endorse it in full to the Treasurer of the United States.

5. Margaret Farrell was paid by check for her baby-sitting job. Her employer always calls her Peggy, and made out the check to Peggy Farrell. How should Margaret endorse the check, if she wishes to use it to pay for a book purchased at the Town Book Shop?

The Cost of Checking Accounts

The services a bank gives in connection with a person's checking account must be paid for. At the end of each month, your bank supplies you with a statement of your account, including a report of the service charge. It also supplies you with your cancelled checks; that is, the checks that have been presented to the bank for payment. These cancelled checks are receipts which you should keep, for they prove that you have made certain payments.

Service Charges

The more checks a person draws, the more work the bank tellers must do, and the same is true regarding deposits. Therefore banks charge fees. For example, a bank may charge $.05 for each check drawn and $.03 for each deposit.

Because checking accounts with small balances cost the bank more to maintain than accounts with large balances, many banks have, in addition to the fee for checks and deposits, a schedule of charges such as this:

Average Daily Balance	*Service Charge or Credit*
Less than $100	$.25 additional service charge each month
$100 to $199	No additional service charge
$200 and above	$.10 credit for each $100 of balance (Fractions of $100 are dropped)

You can see that it is to your advantage to keep a substantial balance in your checking account. You pay less for the bank's services when you do so.

Example

Mr. Hoffman's average daily bank balance for the month of September was $450. During the month the bank paid 27 checks for him, and he made 3 deposits. If the bank charges were those given above, how much was charged against Mr. Hoffman's account?

What to Do	How to Do It
(1) Find the charge for checks drawn.	27 × $.05 = $1.35
(2) Find the charge for deposits.	3 × $.03 = $ .09
(3) Add the charges.	$1.35 + $.09 = $1.44
(4) Look up the average daily bank balance in the schedule to learn whether there is either an additional charge or a credit.	$450 is over $200; so there is a credit of $.10 per $100
(5) Find the credit.	4 × $.10 = $ .40
(6) Find the net charge.	$1.44 − $.40 = $1.04 Answer

PROBLEMS

1. The average daily balance in Mr. Conrad's checking account for the month of June was $547. During the month he wrote 17 checks and made 2 deposits. Find the net service charge according to the rates on pages 262 and 263.

2. Mr. Pearson wrote 22 checks and made 5 deposits during the month of February. According to the rates on pages 262 and 263, what was the net service charge if his average daily balance was $850?

3. A certain bank has a service charge that depends entirely upon the average daily balance regardless of the number of checks written. There is no charge when the average daily balance is $300 or more; the charge per month is $.50 for an average daily balance between $200 and $300, $1.00 for a balance between $100 and $200, and $1.50 for a balance under $100.

Mr. Wartko wrote 12 checks and made three deposits one month. His average daily balance was $250.

a. Find the service charge made against his account.
b. Find the service charge per check drawn.

4. James Howland wrote 20 checks and made 4 deposits one month. His average daily balance was $385. His bank charges a flat fee of $1.50 per month on all checking accounts, but allows a credit of $.25 per month for every $100 of average daily balance up to $600.

a. Find the service charge made against Mr. Howland's account.

b. Find the cost to Mr. Howland of each check that he wrote.

5. A bank allows a free check for each $10 of average daily balance, and charges $.05 per check for all other checks. This bank charges $2.00 on all accounts under $100, $1.50 on all accounts between $100 and $200, $1.00 on accounts between $200 and $300, and $.50 on accounts between $300 and $400. There is no charge for deposits. H. C. Morse wrote 5 checks and made 1 deposit during the month of April. Find the net service charge if his average daily balance was $185.

6. A bank charges a fee of $1.00 per month on all accounts under $500 average daily balance. The fee for each check drawn or deposit made is $.05. However, for every $100 of balance, 1 deposit can be made and 5 checks can be drawn without charge. Frederick Sheridan wrote 12 checks and made 12 deposits in August. Find the net service charge if his average daily balance was $168.

7. One month the King Hardware Company had an average daily balance of $685 in a checking account. During the month the company treasurer wrote 65 checks and made 18 deposits. The service charge was made according to the following schedule:

Flat charge on all accounts	$.25
Fee for each check drawn	.06
Fee for each deposit	.03
Credit per $100 of balance	.10

Find the service charge made against the account of the King Hardware Company.

8. A department store had an average daily balance of $1250 during the month of May. The same month the store treasurer wrote 255 checks and made 24 deposits. Find the service charge according to the following schedule:

Fee for each check drawn	$.06
Fee for each deposit made	.04
Credit for each $100 of balance over $200	.08

9. Carl Summers had a balance of $177.83 in his checking account on November 1. During the month he wrote checks and made deposits as follows:

November	2	Deposited	$210.48
	3	To Klein and Gross Department Store	14.76
	8	To Lindsay Callahan, M.D. . . .	10.00
	19	To Bluestone Coal Company . . .	35.60
	24	Withdrew cash	25.00

a. Find his balance on December 1 before allowing for the service charge.

b. If the bank charges $.05 for each check drawn and for each deposit made, but has no other service charge for accounts

with an average daily balance over $100, what service charge was made against Mr. Summers' account?

c. What was Mr. Summers' checkbook balance on December 1 after he had deducted the service charge?

10. On August 1, Sandra Warsky had a balance of $281.32 in her checking account. During August, she wrote checks and made deposits as follows:

August	3	Deposited	$300.00
	5	To Personal Book Store	3.15
	10	To Franklin Klinger's Grocery . .	30.70
	17	To Midwood Dress Shop	24.90
	25	To Claire Powers	4.10

a. Find her balance on September 1, before allowing for the service charge.

b. Mrs. Warsky's bank charges $.06 for each check drawn and for each deposit made. A credit of $.08 is allowed on accounts with an average daily balance between $500 and $600. What service charge was made against Mrs. Warsky's account for August?

c. What was Mrs. Warsky's checkbook balance on September 1 after she had deducted the service charge?

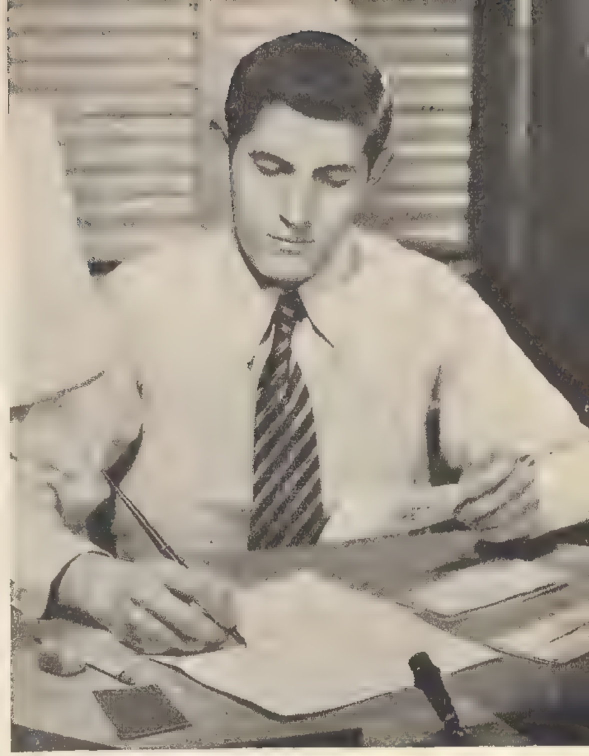
The Bank Statement

Your bank statement gives you the following information:

(1) Your balance at the end of the previous month.
(2) The dates your checks were cashed by the bank.
(3) The dates you made deposits.
(4) Your balance in the bank each time a check was paid or a deposit made.
(5) Other charges against your account.
(6) Your balance the day the bank sent the statement to you.

Your balance as reported by the bank usually does not agree with the balance that you have recorded in your checkbook. For one thing, it almost always happens that some of your checks are not presented for payment during the month. You may have made a deposit or written checks after the bank

statement was prepared. Or you may have made an error in recording your checks or in subtracting or adding the amounts entered on your stubs. There may even be an error in the bank's record, although that is very unlikely. At any rate, you should *reconcile* your balance; that is, you should compare your record with the bank's record.



GALLOWAY

This young man is comparing the cancelled checks sent him by the bank with the bank statement.

To reconcile your balance, first subtract the service charge from your checkbook balance. Then arrange the cancelled checks by number and compare them with the checkbook stubs. Note what checks have not been returned. Unreturned checks are called *outstanding checks*. They have not yet been cashed.

The next step is to add together the amounts for which the outstanding checks were drawn, and subtract the total from the balance reported by the bank. If you have made no deposits that the bank has not reported, this difference will be your *adjusted balance.*

If the difference does not agree with your checkbook balance, examine the record of your deposits in your passbook. Compare it with the bank statement. If you have deposited any money that the bank has not reported, add the amount to the difference you found. The sum is your adjusted balance.

Your adjusted balance and your checkbook balance should be the same. If they are not, go over your checkbook carefully; repeating the computations and comparing the amounts on the stubs with those on the checks and in the passbook. The chances are that you made a careless error somewhere.

Example

Mr. Gray's checkbook shows a balance of $242.55. His bank statement shows a balance of $246.20. The service charge was $.85. There are outstanding checks for $25.00 and $32.50. He also finds a deposit of $53.00 made too late to be recorded in this bank statement. Reconcile the accounts.

What to Do	How to Do It
(1) Subtract the service charge from the *checkbook* balance.	$242.55 − $.85 = $241.70 Adjusted checkbook balance
(2) Add together the amounts of the outstanding checks.	$25.00 + $32.50 = $57.50
(3) Subtract the sum of the outstanding checks from the *bank-statement* balance.	$246.20 − $57.50 = $188.70
(4) Add the deposit made too late to appear in this statement.	$188.70 + $53.00 = $241.70 Adjusted bank-statement balance
(5) Compare the adjusted checkbook balance with the adjusted bank-statement balance.	The two balances are the same. Answer

PROBLEMS

Reconcile the balances in each of the following problems. If an adjusted checkbook balance does not agree with an adjusted bank-statement balance, tell how large an error was made.

1. At the end of January, Mr. Crane's checkbook stubs and the bank statement compared as follows:

Checkbook balance:	$322.56
Bank-statement balance:	314.38
Service charge:	.97
Outstanding checks:	7.58; 10.21
Unrecorded deposit:	25.00

2. At the end of October, Mr. Thompson's checkbook stubs and the bank statement compared as follows:

Checkbook balance:	$333.42
Bank-statement balance:	314.60
Service charge:	1.25
Outstanding checks:	28.40; 44.83
Unrecorded deposits:	30.00

3. On February 1, Mr. Riley's bank statement and checkbook stubs showed the following facts:

Checkbook balance:	$125.10
Bank-statement balance:	137.40
Service charge:	.81
Outstanding checks:	9.30; 3.81

4. At the end of the month of July, Mr. West found that the record on the stubs of his checkbook and the bank statement compared as follows:

Checkbook balance:	$279.91
Bank-statement balance:	315.75
Service charge:	.62
Outstanding checks:	25.16; 11.30

5. Mr. Lane's comparison of his checkbook and his bank statement showed the following:

Checkbook balance:	$130.20
Bank-statement balance:	175.60
Service charge:	.78
Outstanding checks:	15.70; 5.40; 23.80; 19.12

6. A comparison of Mr. Younger's checkbook and the bank statement on December 1 showed the following facts:

Checkbook balance:	$210.82
Bank-statement balance:	269.10
Service charge:	.46
Outstanding checks:	36.25; 10.74; 11.79

7. On May 1, Mr. Reynolds' checkbook balance was $167.82. That day he received a bank statement which showed a balance of $175.05 and a service charge of $.90. There were four outstanding checks: $8.15, $20.28, $9.80, $23.50. There was also an unrecorded deposit of $20.00.

GALLOWAY

When you pay your bills by check, your stub supplies a record, and your cancelled check is your receipt.

How large an error should Mr. Reynolds attempt to find in his checkbook?

8. Mr. Grant's checkbook balance on February 1 was \$283.57. His bank statement, received that day, showed a balance of \$255.83 and a service charge of \$.59. There were three outstanding checks: \$18.25, \$9.73, and \$54.27. There was also an unrecorded deposit of \$110.50. How large an error should Mr. Grant look for in his checkbook?

9. Mrs. Coyle's checkbook balance on September 1 was \$417.22. The bank-statement balance was \$522.43, and the service charge was \$.73. Two checks had not been returned, one for \$5.25, and the other for \$100. Mrs. Coyle had made no deposits since August 15. How large an error should she look for in her checkbook?

10. Mrs. Eldridge's checkbook balance on March 1 was \$192.00. Her bank-statement balance was \$141.68, and there was a service charge of \$.45. Three checks were outstanding, one for \$45.00, one for \$6.18, one for \$2.45. On February 28, Mrs. Eldridge had deposited \$48.30 that had not been recorded. How large an error should she look for in her checkbook?

Special Checking Accounts

Many banks maintain special checking accounts. These are especially useful if you write only a few checks each month and do not want to keep a large balance in your checking account. Usually the only regular service charge is \$.10 for each check drawn. You pay this charge in advance, by buying your checkbook.

There are a few other ways in which a special checking account differs from a regular checking account. (1) You do not have a separate passbook. Your checkbook has a page on which deposits are recorded. (2) You receive a bank statement only once in three months, not once a month. You can, however, have a bank statement at any time by paying a special fee, which is usually $.50.

PROBLEMS

1. Conrad Wills uses a special checking account on which the service charge is $.10 for each check with no charge for deposits. He usually writes three checks and makes two deposits each month. How much does he pay per year for the convenience of a special checking account?

2. Mr. Ware's average daily balance one month was $85. During the month he wrote 5 checks and made 2 deposits. His bank has a service charge of $.06 for each check drawn and of $.03 for each deposit. On accounts averaging less than $100 there is an additional monthly charge of $.25. If this month is typical, should Mr. Ware close this account and open a special account in which the only charge is $.10 per check? Explain your answer.

3. Maurice Green wrote 16 checks and made 2 deposits during the month of April. His average daily balance was $75. He paid a service charge of $.25 because his balance fell below $100; and in addition he paid $.05 for each check and $.04 for each deposit. Mr. Green's transactions during April were typical of those in other months. Would you advise him to close this checking account and open a special account in which the only charge is $.10 per check? Explain your answer.

4. Mary Marsh has a new job in which her take-home pay is $37.22 each week. She plans to keep $15 in cash each week and deposit the rest of her pay in a checking account. Once a month she will write a check for her board and room and a check to a department store in which she has a charge account. She does not expect to write more than three other checks a month. She can open a special checking account that will

cost her only $.10 per check, or she can open an account in a bank that charges $.02 per deposit and $.05 per check drawn, in addition to a service charge of $.25 per month on all accounts with an average daily balance under $200. What would you advise? Explain your answer.

5. William Reed has an account in a bank whose service charges are as follows: $.06 per check drawn; $.04 per deposit made; $.25 fee if the average daily balance is below $100; $.10 credit per $100 if the average daily balance is above $200. William's take-home pay is $42.40 per week; his balance is ordinarily between $100 and $200. Usually he draws 5 checks a month, and deposits his pay check each week. He is considering closing this account and changing to a special account in which the only charge is $2.00 for a checkbook of 20 checks. What would you advise him to do? Explain your answer.

Sending and Carrying Money Safely

If you do not have a checking account, you can safely send money by mail by using *postal money orders*. If it is necessary to send money very quickly from one place to another, you can use a telegraph money order.

When you are to be away from home for some time, you must find a safe way to carry enough money to meet your expenses. Unless you are going where you are known or can establish credit, you will not find ordinary personal checks satisfactory, for you will be unable to cash them. However, you can take money in the form of *travelers checks*. These you can cash almost anywhere. Your signature like that on the checks identifies you.

Figure 7–5

Application for Domestic Money Order

Spaces below to be filled in by purchaser, or, if necessary, by another person for him

Amount—
USE *FIGURES*, DO NOT SPELL 75 Dollars 15 Cents

To be paid to William J. Morse
(Name of person or firm for whom order is intended)

Whose address is 1450 N. Main St. Street
City and State Bartow, Illinois

Sent by H. J. Burton
(Name of sender)
1256 E. 18th St. Street
City and State Lakewood, California

PURCHASER MUST SEND ORDER TO PAYEE
(FOR FEES SEE OTHER SIDE) 09—16—6391—9

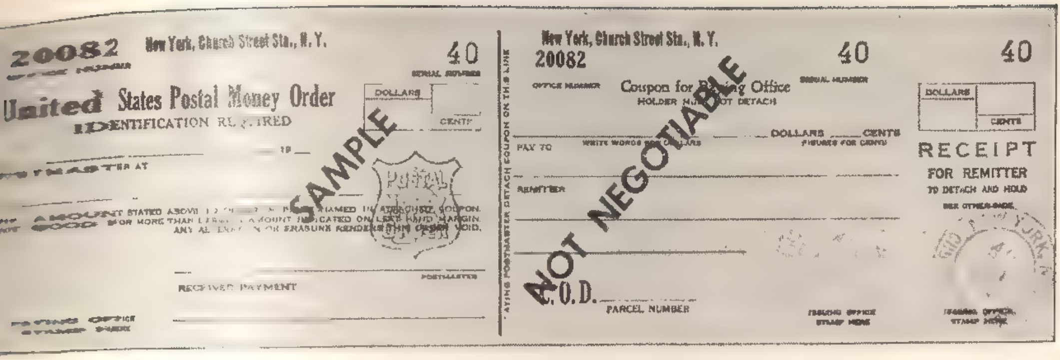


Figure 7–6

Sending Money by Mail

At any post office you can buy *postal money orders* in amounts from \$.01 to \$100. When you wish to send money by means of a postal money order, you first get an application blank like the one shown in Figure 7–5. You fill it in completely and present it to the postmaster. This application is usually found on the writing desk of the post office.

Examine the application in Figure 7–5 and answer the following questions regarding it:

(1) What amount of money was sent?

(2) By whom was the money sent?

(3) To whom was the money sent?

After you have paid the postmaster the amount of money you wish to send, plus a small fee, he will give you a money order similar to the one shown in Figure 7–6. H. J. Burton, Figure 7–5, would give the postmaster \$75.15, plus a \$.35 fee. He would then receive a money order for \$75.15 made payable to William J. Morse. He would also receive a receipt, which he would keep. Then he would mail only the money order to Mr. Morse.

When Mr. Morse receives the money order, he may cash it at any post office. To do this he must sign his name in the space provided and in the presence of the postmaster. While the person who sends a money order must pay a fee depending upon the amount of money he wishes to send, the person who cashes it does not, but receives the full amount of the money order.

The cost of the money order is given on the back of each application. See Table 6.

Table 6. CHARGES FOR POSTAL MONEY ORDERS

Amount	*Charge*
From $.01 to $5.00	$.10
From $5.01 to $10.00	.15
From $10.01 to $50.00	.25
From $50.01 to $100.00	.35

Express money orders are similar to postal money orders. You can buy them at any express agency. The rates are shown in Table 7.

Table 7. CHARGES FOR EXPRESS MONEY ORDERS

Amount	*Charge*
From $.01 to $5.00	$.10
From $5.01 to $10.00	.15
From $10.01 to $50.00	.25
From $50.01 to $100.00	.30

If you must send more than $100 through the mails, you may buy several postal or express money orders, or you may buy a *bank money order.* A bank money order is much like a personal check. You deposit the amount you wish to send and fill in and sign the order form. Of course, banks charge a fee for this service.

If you have a savings account, your bank will give you money in the form of a *cashier's check.* A cashier's check is drawn on the bank's own funds, and is signed by a representative of the bank. This service is available only to depositors, and usually there is no charge.

PROBLEMS

Refer to Tables 6 and 7 as necessary while solving these problems.

1. What fee would you pay to send a postal money order for:

a. $5.00	**c.** $14.85	**e.** $60.05
b. $20.10	**d.** $80.00	**f.** $ 3.29

2. Find the fees for express money orders of the following amounts:

a. $2.10	**c.** $37.50	**e.** $25.45
b. $3.65	**d.** $14.19	**f.** $76.00

3. For what amounts is the cost of sending money the same by postal money order as it is by express money order?

4. Mr. Allen ordered seeds by mail. His order amounted to $12.50, and he sent $.29 additional for postage. If he paid the bill by express money order, what was the total cost to him?

5. Mr. Wilson ordered a motor costing $130.75 and sent a bank money order in payment. The bank charged him $.25.

a. How much less did he pay than he would have paid for postal money orders of the same amount?

b. How much less did he pay than he would have paid for express money orders of the same amount?

Wiring Money

Sometimes an emergency arises in which you have to send money from one place to another more rapidly than can be done by mail. In such a case you send a telegraph money order. This procedure is expensive, for you must pay the price of a telegram (plus a Federal tax) plus a fee for the money order. You have a choice of two types of telegram: the full-rate telegram, which is sent as rapidly as possible, and the less expensive over-night telegram, in which delivery is made the next morning. The fee for the money order is the same no matter which service is used. Table 8, page 277, shows the fees charged for money orders.

Example

Mr. Nichols sent a money order for $37.50 by full-rate telegram. The charge for a money-order message was $.80 plus Federal tax of 10%. How much did it cost Mr. Nichols to send the money so rapidly?

What to Do	How to Do It
(1) Find the amount of the tax.	.10 × $.80 = $.08
(2) Find the total cost of the telegram.	$.80 + $.08 = $.88
(3) Find the charge for the money order on the schedule, and add it to the total cost of the telegram.	$.50 + $.88 = $1.38 Answer

PROBLEMS

Refer to Table 8, page 277, in solving these problems. Add a 10% Federal tax to the charge for the message.

1. How much will it cost Mr. Arnold, who lives in Buffalo, to send a full-rate telegraph money order of $38.50 to Pittsburgh? The charge for the message is $.80 plus tax.

2. In order to close a business deal, Mr. Miles sent an overnight telegraph money order for $785. The message, not counting tax, cost $.60. How much did it cost Mr. Miles to send the money order?

3. While he was on an automobile trip, Mr. Green's car broke down. He wired his bank for $75, which was sent by full-rate telegram. The cost of the telegram was $.65 plus tax. How much money did the bank deduct from Mr. Green's account?

4. When Mr. Bosworth's tractor broke down, he telegraphed a full-rate money order for a new part costing $35.50. If the charge for the message was $.55, exclusive of tax, how much money did he pay at the telegraph office?

5. While in St. Louis, Mr. Bryant of Philadelphia lost his wallet. He sent his wife a collect telegram explaining his misfortune, for which she had to pay $1.10 plus tax. She sent him an overnight telegraph money order for $100. The charge for the message was $.80 plus tax. How much did Mrs. Bryant have to pay the telegraph company in addition to the $100?

Table 8. FEES CHARGED FOR TELEGRAPH MONEY ORDERS

Amount	Charge
$ 20.00 or less	$ .30
20.01 to $ 25.00	.35
25.01 to 30.00	.40
30.01 to 35.00	.45
35.01 to 40.00	.50
40.01 to 45.00	.55
45.01 to 50.00	.60
50.01 to 60.00	.70
60.01 to 70.00	.80
70.01 to 80.00	.90
80.01 to 90.00	1.00
90.01 to 100.00	1.10
100.01 to 125.00	1.30
125.01 to 150.00	1.50
150.01 to 175.00	1.70
175.01 to 200.00	1.90
200.01 to 250.00	2.20
250.01 to 300.00	2.50
300.01 to 350.00	2.80
350.01 to 400.00	3.10
400.01 to 450.00	3.40
450.01 to 500.00	3.70
500.01 to 600.00	4.10
600.01 to 700.00	4.50
700.01 to 800.00	4.90
800.01 to 900.00	5.30
900.01 to 1000.00	5.70

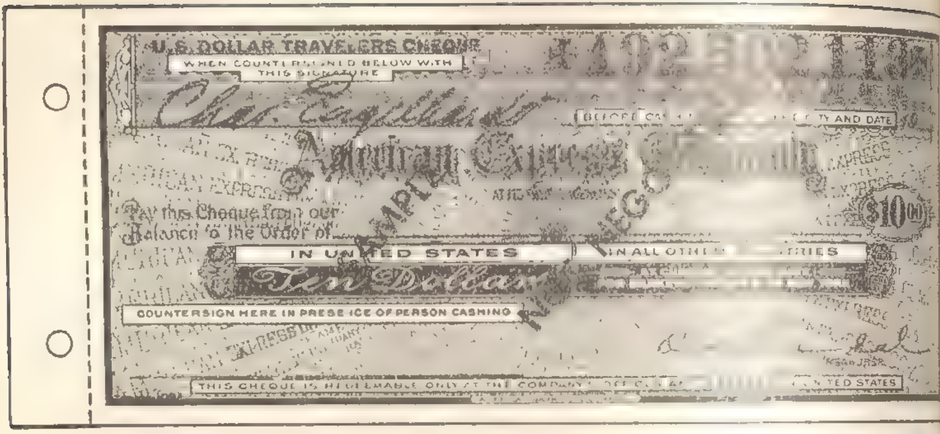


Figure 7-7

Travelers Checks

Figure 7–7 shows a travelers check. You can buy travelers checks in banks and express agencies. They are available in denominations of $10, $20, $50, and $100, and are used like bills of those denominations. The charge for $50 worth of traveler's checks, or less, is $.40. When you buy more than $50 worth at a time, you pay .75 per cent of the total amount.

Suppose you want ten $10 travelers checks. You pay the bank or express agency $100 plus a fee of $.75, and receive ten $10 checks. You sign all ten checks in the presence of the person who gave them to you.

Whenever you use a travelers check, you sign it a second time in the presence of the person to whom you give it. That person can then compare the two signatures.

PROBLEMS

1. When Arthur Farrel started on an automobile trip, he bought twenty $10 travelers checks.

a. What was the service charge for the checks?

b. How much money did Mr. Farrel give the bank where he bought the checks?

2. Before starting on a trip, Mr. Lane purchased ten $20 travelers checks.

a. What was the service charge for the checks?

b. How much money did Mr. Lane pay the Express office where he bought the checks?

3. Find the charge on purchases of travelers checks shown below:

a. Four $10 checks

b. Seven $20 checks and a $10 check

c. Five $100 checks, five $20 checks, and five $10 checks

4. Find the charge on purchases of travelers checks as follows:

a. Five $20 checks

b. Three $100 checks and a $50 check

c. Four $50 checks, six $20 checks, and five $10 checks

5. William Warburton purchased six $50 traveler's checks and ten $20 travelers checks. In payment, he wrote a check on the Carnarvon Trust Company, where he maintains a regular checking account. For what amount was the check?

What You Have Learned in This Chapter

1. To open a checking account
2. To make out deposit slips
3. To write checks and fill in stubs
4. To endorse checks in full, in blank, and with restricted endorsements
5. To compute the costs of checking accounts
6. To reconcile a checkbook balance with a bank-statement balance
7. To send money by postal notes, postal money orders, and express money orders
8. To send money by telegram
9. To use travelers checks
10. To understand these terms: *signature card, passbook, cashier's check*

Review Test on Checks and Money Orders

1. On March 13, L. P. Walters of Bogota, California, deposited coins and bills as follows in the Orange Growers' Bank of Bogota:

1 hundred-dollar bill	7 silver dollars
3 twenty-dollar bills	6 half dollars
5 ten-dollar bills	29 quarter dollars
11 five-dollar bills	28 dimes
18 dollar bills	21 nickels

He also deposited a check for $82.51 drawn on the Bank of America in San Francisco and checks for $27.30 and $13.98 on the Orange Growers' Bank of Bogota. Prepare Mr. Walters' deposit slip.

2. Fred Evans had a balance in his checking account on March 18 of $315.90. On that day he wrote check number 35 for $12.50 to R. M. Chase in payment of a doctor bill. Show the completed check and stub.

3. Earl Nichols received a check for $7.50 from G. H. Corning. He used the check to pay Richard Miller $7.50. Show the endorsement.

4. Harold Riley had a balance of $180.73 in his checking account on May 1. During the month he wrote the following checks and made the following deposits:

Checks: $17.50; $50.00; $14.25; $8.17; $4.18; $35.12
Deposits: $75.00; $82.50

Find his checkbook balance at the end of the month.

5. During the month of December, Mr. Davis had an average daily balance of $340 in his checking account. During the month he wrote 22 checks and made 4 deposits. Find the service charge made against his account, if his bank uses the following schedule:

Flat charge on all accounts:	$.50
Fee for each check drawn:	.06
Fee for each deposit:	.04
Credit per $100 of balance:	.10

6. Mr. Glenn's checkbook balance on May 1 was $417.83. His bank-statement balance on May 1 was $415.75. The statement showed a service charge of $.78. There were three outstanding checks, one for $18.00, one for $3.75, and one for $12.15. On April 30 Mr. Glenn had mailed a deposit of $35.00, which he had added in his checkbook, but which the bank had not yet recorded. Reconcile the balances. If they do not agree, tell how large an error Mr. Glenn should look for in his checkbook.

7. Victor Ford uses a special checking account on which the service charge is $.10 on each check and $.10 for each deposit. He usually writes five checks and makes four deposits each month. How much does his checking account cost him per year?

8. Susan Samuels has a checking account in a bank that charges $.05 for each check drawn and for each deposit made. There is a flat fee of $.25 on all accounts and a credit of $.10 per $100 balance on accounts averaging over $200 per month. Miss Samuels usually writes 8 checks and makes one deposit monthly. Her average daily balance is between $200 and $300. She is considering closing her account and opening a special checking account that will cost her $.10 per check. Would you advise her to do so? Explain your answer.

9. Mr. Kelly wishes to send a mail-order house a total of $12.13 with his order. He has no checking account. What should he do?

10. Suppose you are cashier in a restaurant. A stranger asks you to accept a check in payment for the meals he and his companions have eaten. Their bill came to $6.25. Which of these would you accept? Explain.

a. A personal check for the exact amount of the bill.
b. A travelers check for $20, giving $13.75 in change.

How do you rate?	Excellent	Good	Fair	Poor
	10	8–9	6–7	5 or less

Check-Up Tests on Computation

Most of the problems you have been solving required the use of arithmetic. To check your accuracy in computation, take the following tests.

TEST ON WHOLE NUMBERS

Find these sums:

1)	2)	3)	4)	5)
920	827	485	92	605
395	735	840	180	957
4039	36	84	81	14
54	801	509	256	23
25	25	70	370	603

6)	7)	8)	9)	10)
263	6050	798	7041	38
9062	402	517	284	824
362	69	17	140	647
21	78	76	43	90
58	158	803	36	936

11)	12)	13)	14)	15)
486	283	716	374	2071
739	179	846	951	391
95	492	25	473	270
698	45	712	10	67
81	81	14	69	69

16)	17)	18)	19)	20)
909	152	939	587	494
406	173	513	28	3068
28	51	58	606	503
965	32	89	87	34
14	247	47	792	92

Find these differences:

21) $\begin{array}{r}87649\\ \underline{82450}\end{array}$ **22)** $\begin{array}{r}81005\\ \underline{13892}\end{array}$ **23)** $\begin{array}{r}57580\\ \underline{10978}\end{array}$ **24)** $\begin{array}{r}36017\\ \underline{15970}\end{array}$

25) $\begin{array}{r}96271\\ \underline{10852}\end{array}$ **26)** $\begin{array}{r}53617\\ \underline{34708}\end{array}$ **27)** $\begin{array}{r}83841\\ \underline{47501}\end{array}$

28) $\begin{array}{r}92439\\ \underline{49085}\end{array}$ **29)** $\begin{array}{r}70973\\ \underline{62439}\end{array}$

30) $\begin{array}{r}51214\\ \underline{16857}\end{array}$ **31)** $\begin{array}{r}96422\\ \underline{78296}\end{array}$ **32)** $\begin{array}{r}91291\\ \underline{35204}\end{array}$ **33)** $\begin{array}{r}82435\\ \underline{20916}\end{array}$

34) $\begin{array}{r}149872\\ \underline{87645}\end{array}$ **35)** $\begin{array}{r}365093\\ \underline{76423}\end{array}$ **36)** $\begin{array}{r}728093\\ \underline{36694}\end{array}$

37) $\begin{array}{r}408261\\ \underline{15733}\end{array}$ **38)** $\begin{array}{r}562694\\ \underline{90134}\end{array}$ **39)** $\begin{array}{r}748573\\ \underline{59826}\end{array}$ **40)** $\begin{array}{r}118750\\ \underline{61327}\end{array}$

Find these products:

41) $\begin{array}{r}59\\ \underline{24}\end{array}$ **42)** $\begin{array}{r}60\\ \underline{78}\end{array}$ **43)** $\begin{array}{r}83\\ \underline{24}\end{array}$ **44)** $\begin{array}{r}20\\ \underline{24}\end{array}$ **45)** $\begin{array}{r}905\\ \underline{91}\end{array}$

46) $\begin{array}{r}824\\ \underline{19}\end{array}$ **47)** $\begin{array}{r}164\\ \underline{30}\end{array}$ **48)** $\begin{array}{r}3617\\ \underline{19}\end{array}$

49) $\begin{array}{r}2570\\ \underline{30}\end{array}$ **50)** $\begin{array}{r}604\\ \underline{65}\end{array}$

51) $\begin{array}{r}931\\ \underline{56}\end{array}$ **52)** $\begin{array}{r}983\\ \underline{30}\end{array}$ **53)** $\begin{array}{r}47\\ \underline{87}\end{array}$ **54)** $\begin{array}{r}47\\ \underline{42}\end{array}$ **55)** $\begin{array}{r}16\\ \underline{42}\end{array}$

56) $\begin{array}{r}25\\ \underline{65}\end{array}$ **57)** $\begin{array}{r}81\\ \underline{78}\end{array}$ **58)** $\begin{array}{r}92\\ \underline{78}\end{array}$

59) $\begin{array}{r}78\\ \underline{56}\end{array}$ **60)** $\begin{array}{r}35\\ \underline{87}\end{array}$

Find the following quotients:

61) $35\overline{)905}$ **68)** $18\overline{)9468}$ **75)** $90\overline{)35210}$

62) $46\overline{)920}$ **69)** $64\overline{)5504}$ **76)** $27\overline{)69903}$

63) $53\overline{)848}$ **70)** $81\overline{)6399}$ **77)** $90\overline{)52020}$

64) $18\overline{)1442}$ **71)** $53\overline{)1964}$ **78)** $72\overline{)44151}$

65) $64\overline{)3801}$ **72)** $64\overline{)2176}$ **79)** $27\overline{)19008}$

66) $46\overline{)3271}$ **73)** $35\overline{)2800}$ **80)** $90\overline{)378900}$

67) $53\overline{)2607}$ **74)** $81\overline{)33453}$

How do you rate?	Excellent	Good	Fair	Poor
	76–80	70–75	65–69	64 or less

TEST ON COMMON FRACTIONS

Give each sum in its lowest terms:

1) $\frac{3}{5} + \frac{1}{5}$

2) $\frac{3}{8} + \frac{3}{8}$

3) $\frac{7}{10} + \frac{1}{10}$

4) $\frac{5}{12} + \frac{7}{12}$

5) $\frac{2}{3} + \frac{2}{3}$

6) $\frac{9}{16} + \frac{11}{16}$

7) $5\frac{1}{6} + 4\frac{1}{6}$

8) $5\frac{7}{12} + 2\frac{1}{12}$

9) $\begin{array}{r} 6\frac{1}{3} \\ \underline{4\phantom{\frac{1}{3}}} \end{array}$

10) $\begin{array}{r} \frac{7}{8} \\ \underline{\frac{3}{4}} \end{array}$

11) $\begin{array}{r} \frac{2}{3} \\ \underline{\frac{11}{12}} \end{array}$

12) $\begin{array}{r} \frac{5}{16} \\ \underline{\frac{7}{8}} \end{array}$

13) $\begin{array}{r} 15\frac{5}{6} \\ \underline{7\frac{2}{3}} \end{array}$

14) $\begin{array}{r} 8\frac{7}{12} \\ \underline{3\ \frac{5}{6}} \end{array}$

15) $\begin{array}{r} \frac{3}{5} \\ \underline{\frac{1}{4}} \end{array}$

16) $\begin{array}{r} \frac{3}{4} \\ \underline{\frac{2}{3}} \end{array}$

17) $\begin{array}{r} 5\frac{1}{2} \\ \underline{10\frac{2}{5}} \end{array}$

18) $\begin{array}{r} 15\frac{2}{3} \\ \underline{7\frac{1}{2}} \end{array}$

19) $\begin{array}{r} 12\frac{4}{5} \\ \underline{3\frac{3}{4}} \end{array}$

20) $\begin{array}{r} 15\frac{7}{10} \\ \underline{10\ \frac{3}{4}} \end{array}$

Give each difference in its lowest terms:

21) $\frac{4}{5} - \frac{2}{5}$

22) $\frac{3}{4} - \frac{1}{4}$

23) $\frac{13}{16} - \frac{7}{16}$

24) $14\frac{7}{8} - 8\frac{3}{8}$

25) $12\frac{5}{12} - 3\frac{1}{12}$

26) $16\frac{9}{10} - 9$

27) $5\frac{4}{5} - \frac{1}{5}$

28) $9 - \frac{3}{4}$

29) $\begin{array}{r} 12 \\ \underline{6\frac{5}{12}} \end{array}$

30) $\begin{array}{r} 12\frac{1}{4} \\ \underline{3\frac{3}{4}} \end{array}$

31) $\begin{array}{r} 16\frac{3}{10} \\ \underline{8\frac{7}{10}} \end{array}$

32) $\begin{array}{r} \frac{7}{8} \\ \underline{\frac{1}{4}} \end{array}$

33) $\begin{array}{r} \frac{1}{3} \\ \underline{\frac{1}{12}} \end{array}$

34) $\begin{array}{r} 23\frac{5}{8} \\ \underline{14\frac{1}{2}} \end{array}$

35) $\begin{array}{r} 26\frac{1}{2} \\ \underline{18\frac{7}{8}} \end{array}$

36) $\begin{array}{r} 15\frac{5}{12} \\ \underline{13\frac{2}{3}} \end{array}$

37) $\begin{array}{r} 14\frac{2}{5} \\ \underline{4\frac{1}{2}} \end{array}$

38) $\begin{array}{r} 17\frac{3}{8} \\ \underline{10\frac{2}{3}} \end{array}$

39) $\begin{array}{r} 14\frac{1}{4} \\ \underline{8\frac{5}{6}} \end{array}$

40) $\begin{array}{r} 15\frac{2}{5} \\ \underline{10\frac{7}{10}} \end{array}$

Give each product in its lowest terms:

41) $\frac{1}{6}$ of 42

42) $\frac{1}{3}$ of \$2.70

43) $\frac{1}{8}$ of 176

44) $\frac{4}{5}$ of 65

45) $\frac{3}{10}$ of 7

46) $\frac{7}{8}$ of 52

47) $31 \times \frac{5}{6}$

48) $\frac{3}{4} \times \frac{5}{8}$

49) $\frac{4}{5} \times \frac{5}{6}$

50) $\frac{5}{6} \times \frac{7}{10}$

51) $36 \times 1\frac{1}{2}$

52) $250 \times 4\frac{3}{5}$

53) $5\frac{2}{3} \times \frac{1}{6}$

54) $4\frac{3}{4} \times 8$

55) $17\frac{5}{6} \times 24$

56) $5\frac{1}{4} \times 1\frac{1}{3}$

57) $6\frac{2}{3} \times 1\frac{1}{2}$

58) $2\frac{1}{2} \times 2\frac{2}{5}$

59) $3\frac{3}{8} \times 2\frac{2}{3} \times \frac{5}{16}$

60) $4\frac{3}{8} \times 8 \times \frac{1}{10}$

Give each quotient in its lowest terms:

61) $5 \div \frac{3}{4}$

62) $4 \div \frac{3}{5}$

63) $7 \div \frac{7}{8}$

64) $\frac{1}{4} \div \frac{1}{4}$

65) $\frac{1}{6} \div \frac{1}{3}$

66) $\frac{4}{5} \div \frac{3}{10}$

67) $\frac{5}{6} \div \frac{2}{3}$

68) $\frac{5}{6} \div 5$

69) $\frac{3}{5} \div 10$

70) $\frac{3}{4} \div 8$

71) $3\frac{1}{4} \div 2$

72) $3\frac{1}{3} \div \frac{5}{8}$

73) $4\frac{4}{5} \div 4$

74) $25 \div 1\frac{1}{4}$

75) $\frac{3}{8} \div 2\frac{2}{3}$

76) $14 \div 3\frac{1}{2}$

77) $\frac{2}{3} \div 5\frac{1}{3}$

78) $2\frac{2}{5} \div 3\frac{3}{5}$

79) $8\frac{2}{3} \div 3\frac{1}{4}$

80) $16\frac{1}{3} \div 2\frac{1}{3}$

How do you rate?	Excellent	Good	Fair	Poor
	76–80	70–75	65–69	64 or less

TEST ON DECIMAL FRACTIONS

Add each of the following groups of decimal fractions:

1) .4, .2, .3
2) .9, .7, .4
3) .18, .27, .53
4) .29, .38, .55
5) .05, .37, .46
6) .43, .58, .19, .78
7) .40, .95, .30, .39
8) .89, .98, .47, .62
9) .572, .081, .003
10) .549, .638, .527
11) 3.7, 6.8, 2.9
12) 10.3, 5.6, 8.4
13) 5.39, .44, 8.63
14) 7.38, 9.73, 92.49
15) 12, 8.6, 5.7
16) 7.9, 8.7, 6.4
17) 65.78, 4.39, 61.89
18) 15, .09, 41.78
19) 7.493, .437, 8.041
20) .709, 6.394, .497

Subtract the smaller number from the larger in each pair of numbers:

21) .3, .4
22) .27, .43
23) .86, .85
24) .47, .53
25) .63, .58
26) 3.7, 6.3
27) 31.4, 12.4
28) 61.79, 43.82
29) 13.6, 10
30) 8, 10.1
31) 87, 91.6
32) 4.6, 41
33) 8, .09
34) 6.067, 6.607
35) 47, 40.47
36) 300, 19.75
37) 62.5, 70
38) .07, .075
39) .0607, .0671
40) 3.248, .489

Multiply:

41) $\begin{array}{r} .4 \\ \underline{3} \end{array}$

42) $\begin{array}{r} 32 \\ \underline{.6} \end{array}$

43) $\begin{array}{r} .13 \\ \underline{4} \end{array}$

44) $\begin{array}{r} 54 \\ \underline{.26} \end{array}$

45) $\begin{array}{r} .845 \\ \underline{\quad 4} \end{array}$

46) $\begin{array}{r} 874 \\ \underline{.006} \end{array}$

47) $\begin{array}{r} .5 \\ \underline{.7} \end{array}$

48) $\begin{array}{r} .56 \\ \underline{.8} \end{array}$

49) $\begin{array}{r} .08 \\ \underline{.4} \end{array}$

50) $\begin{array}{r} .36 \\ \underline{.5} \end{array}$

51) $\begin{array}{r} .06 \\ \underline{.07} \end{array}$

52) $\begin{array}{r} 7.6 \\ \underline{1.4} \end{array}$

53) $\begin{array}{r} .84 \\ \underline{7.2} \end{array}$

54) $\begin{array}{r} 350 \\ \underline{.06} \end{array}$

55) $\begin{array}{r} 450 \\ \underline{.015} \end{array}$

56) $\begin{array}{r} .056 \\ \underline{.450} \end{array}$

57) $\begin{array}{r} 205.4 \\ \underline{.38} \end{array}$

58) $\begin{array}{r} 8.64 \\ \underline{6.2} \end{array}$

59) $\begin{array}{r} 18.75 \\ \underline{.20} \end{array}$

60) $\begin{array}{r} 378.50 \\ \underline{.25} \end{array}$

Divide:

61) $2\overline{).8}$

62) $8\overline{).32}$

63) $6\overline{).048}$

64) $7\overline{)32.2}$

65) $27\overline{).1134}$

66) $36\overline{)15.12}$

67) $34\overline{)282.2}$

68) $54\overline{)3.51}$

69) $5\overline{)4}$

70) $25\overline{)18}$

71) $10\overline{)5.7}$

72) $100\overline{)3.5}$

73) $1000\overline{)71.6}$

74) $.8\overline{).96}$

75) $.06\overline{).438}$

76) $3.5\overline{)32.55}$

77) $38.4\overline{)99.84}$

78) $6.25\overline{)50}$

79) $1.23\overline{)13.17}$

80) $9.08\overline{)97.12}$

How do you rate?	Excellent	Good	Fair	Poor
	76–80	70–75	65–69	64 or less

TEST ON PER CENTS

1) Find 7% of 128.
2) 18% of 85 = ?
3) How much is 85% of 850?
4) $66\frac{2}{3}\%$ of 96 = ?
5) 5.5% of 480 = ?
6) $\frac{1}{2}\%$ of 26 = ?
7) Find .25% of 180.
8) What is 2.35% of 40?
9) Find .1% of 2500.
10) $3\frac{1}{3}\%$ of 360 = ?
11) 400% of 1.25 = ?
12) 2.06% of 3.6 = ?
13) Find 58 per cent of 260.
14) What is $8\frac{1}{2}\%$ of 1028?
15) What number is 15 per cent more than 80?
16) What number is $33\frac{1}{3}$ per cent more than 96?
17) What is 25 per cent less than 980?
18) What is a 9 per cent increase over 220?
19) What is an increase of 150 per cent over 140?
20) What is $150 decreased by 18 per cent?

How do you rate?	Excellent	Good	Fair	Poor
	20	18–19	15–17	14 or less

UNIT THREE

Money When You Want It

CHAPTER 8

NATIONAL SHAWMUT BANK

1. Find out what you must do to open a savings account in a local bank. What interest rate does the bank pay? What rules are followed in crediting interest to savings accounts?
2. Investigate just how to go about using the facilities of the post office to save money.
3. Find out about government campaigns to get people to invest in Series E Savings Bonds.
4. Get information about savings and loan associations in your community. How may shares be purchased? What dividend rates are paid?
5. Investigate credit unions in your community. What dividends have they been paying? What expenses do they have?

INVESTING YOUR MONEY

WHEN YOU SAVE a dollar, you are not giving up your right to spend it. You are postponing your spending. When you have accumulated enough money, you may spend it for something you want — an automobile, perhaps, or a television set, or even a home of your own. If misfortune or illness befall you, you may draw on your savings to keep out of debt or to make a new start toward success.

While you are waiting to spend your savings, you should keep them in a safe place. At the same time, you can use them to earn more money for you; that is, you can invest them. Before deciding upon any particular investment you should be sure you know the answers to the following questions concerning it:

(1) *Will my money be safe?* This should be your first consideration. After you have worked hard and have managed to save a part of your earnings, you would be most unwise to put your money into an unsafe venture.

(2) *What rate of interest will my savings probably earn for me?* One main reason for investing your money is to have it earn more money. In general, the higher the rate of interest the more risky the investment.

(3) *How easily and quickly can I get my money back if I need it?* If an emergency should arise, you may wish to have a part or all of your investment returned to you to help you through the difficulty.

Bank Savings Accounts

When you keep your money in a bank savings account, the bank uses it and pays you interest on it. You cannot draw checks on a savings account, but you can withdraw your money when you want to do so. There are Federal and State laws that control the activities of your bank. Most banks (over 13,500 of them) are protected by the Federal Deposit Insurance Corporation, which insures each depositor's account up to $10,000.

Figuring Interest on Savings Accounts

You can think of the money in your savings account as money that you have lent to the bank. This money is called your *principal*. Since the bank is in debt to you, it pays you interest. (Do you see the difference between a checking account and a savings account? When you have a checking account, the bank is doing something for you, and you pay a fee for this service. When you have a savings account, you are doing something for the bank, and are paid for it.)

The amount of interest you receive depends on the amount of your principal, the interest rate, and the length of time the bank has your money. Suppose you have $104 on deposit for six months in a bank that pays interest at the rate of 1 per cent per year. To find the amount of your interest, first express the interest rate as a decimal fraction and express the length of time in years; then find the product of the principal, the rate, and the length of time.

Principal: $104
rate per year: .01
time in years: $\frac{1}{2}$

$$\text{Interest} = \$104 \times .01 \times \tfrac{1}{2} = \$.52$$

$$\text{Interest} = \text{Principal} \times \text{rate per year} \times \text{time in years}$$

$$I = P \times r \times t$$

This "posting machine" records the amount deposited in a savings account both in the depositor's bank book and in the bank's record.

The last line on page 294 shows a short way of writing directions for finding interest. These short directions are called the *interest formula.* Sometimes the interest formula is written without the multiplication signs, thus: $I = Prt$. Its meaning when written this way is exactly the same as when the multiplication signs are included; remember that the amounts are to be multiplied.

Most banks pay interest twice a year, on certain fixed dates, such as January 1 and July 1. They do not pay interest on money that has been on deposit for less than a month, or on very small principals; for instance, on less than $3.00. Nor do they pay interest on fractions of a dollar. For example, if you had $132.77 on deposit, your principal would be considered as $132 when interest was computed.

In general, the rate of interest paid on savings accounts is between 1 per cent and 3 per cent per year. Unless you withdraw your interest, it is added to your deposits, and becomes a part of your principal for the next interest period. When interest is added to the principal in this way, it is said to be *compounded.* Savings banks pay *compound interest.*

Example

After interest due on January 1 had been added to his balance, Charles Gordon had \$147.84 in his savings account. He deposited \$60.10 on February 23 and \$30 on June 10. The bank pays interest at the rate of 2 per cent per year, compounded on January 1 and on July 1. How much money did Charles have in his account on July 2?

What to Do	How to Do It
(1) Find the amounts on which interest was paid and the length of time each principal drew interest.	Amount in bank on Jan. 1: \$147.84 Interest-drawing principal: \$147 Time — Jan. 1 to July 1: 6 mo. = $\frac{1}{2}$ yr. Amount deposited on Feb. 23: \$60.10 Interest-drawing principal: \$60 Time — Mar. 1 to July 1: 4 mo. = $\frac{1}{3}$ yr. Amount deposited on June 10: \$30 Time — less than 1 month
(2) Find the interest on each principal; add to get the total interest.	$I = P \times r \times t$ $I = \$147 \times .02 \times \frac{1}{2} = \$1.47$ $I = \$\ 60 \times .02 \times \frac{1}{3} = \$\ .40$ Total interest: \$1.87
(3) Add the total amount on deposit and the total interest.	Amount in bank on Jan. 1: \$147.84 Amount deposited Feb. 23: 60.10 Amount deposited June 10: 30.00 Amount of interest added: 1.87 Amount in bank on July 2: \$239.81 Answer

PROBLEMS

1. The day after Christmas, Charlotte McAdam opened a savings account, depositing a check for \$83.33. She made no deposits or withdrawals until the following August. If her bank pays interest at the rate of $1\frac{1}{2}$ per cent per year, compounded in January and July, how much money did Charlotte have in her account on August 1?

2. After interest had been added to his balance on January

1, Raymond Smith had $275.87 in his savings account at the Farmer's Bank. This bank pays interest at the rate of $1\frac{1}{2}$ per cent per year, compounded in January and July. Raymond made no deposits or withdrawals during the next six months. How much money did he have in his account after interest had been added on July 1?

3. The interest rate of the Mariners' Savings Bank is $1\frac{1}{2}$ per cent per year, compounded on April 1 and October 1. Janet Alexander had a balance of $258.57 after interest had been added on April 1. The only deposit she made during the six-month interest period was one of $50 on August 10. How much money did she have in her account after interest had been added on October 1?

4. Warren Merriam had $273.71 in his savings account after interest was added on July 1. The only deposit he made during the next interest period was $65 on November 20. If the interest rate of his bank is $2\frac{1}{2}$ per cent per year, compounded on January 1 and July 1, what was his balance after the January 1 interest payment had been added?

5. Hubert Decker had $309.27 in his savings account after interest had been added on July 1. He deposited $22.51 on August 23, $25 on October 8, $17.74 on December 12, and made no withdrawals. The bank pays interest at the rate of 2 per cent per year, compounded on January 1 and July 1. How much did Hubert have in his account on January 2?

6. The Drovers' Savings Bank pays interest at the rate of 2 per cent per year, compounding it on the first day of April and October. Donald Evans had $296.49 in his account at the Drovers' Bank after interest had been added on October 1. He deposited $14.10 on November 26, $50 on January 5, and $27.50 on March 13. He made no withdrawals between October and April. What was Donald's balance on April 2?

7. The Mohawk Dime Savings Bank pays interest on the first day of January and July at $2\frac{1}{2}$ per cent per year. After interest was paid on January 1, June Andrews had $50.75 in her savings account. On the fifteenth of each month she deposited $25.00. How much money did she have in her account on July 1, after the interest had been added?

8. The Fairview Five Cents Savings Bank pays interest on January 1 and July 1 at 2 per cent per year. On January 1, after interest had been added, Margery Simmons had \$275.23 on deposit there. On the twentieth of each month she deposited \$20.00. How much did she have in her account on July 1, after interest was added?

9. On September 17 Robert Green opened an account in the Woodville Savings Bank by depositing the \$250 he had earned as a farm laborer during the summer. This bank pays interest at the rate of 2 per cent per year, compounded on October 1 and April 1. If Robert makes no deposits or withdrawals until October 15 of the following year, how much money will he have on deposit at that time? (*Hint:* The interest-drawing principal from April 1 to October 1 is \$250 plus the interest added on April 1.)

10. On Christmas, Sally Shapley received an unexpected gift of \$100. She deposited it immediately in the Salt City Savings Bank, where it drew interest of 2 per cent per year, compounded on January 1 and July 1. If Sally makes no deposits or withdrawals, how much money will she have on deposit 13 months later? (*Hint:* The principal from July 1 to January 1 is \$100 plus the interest added on July 1.)

Using a Compound Interest Table

When money is left in a savings bank at compound interest for a number of years, the principal increases considerably. At 2 per cent compounded semiannually (every six months), it doubles in 35 years. You can verify this statement by figuring the interest as you have been doing. But you would have to make 70 separate interest calculations! If you wanted to find out how much the same amount of money would earn at $2\frac{1}{2}$ per cent interest compounded semiannually for 35 years, you would have to make another 70 interest calculations.

Of course, such calculations have already been made. You can make use of the computations of others instead of going through long computations for yourself. Table 9 shows how every dollar on deposit at various rates of compound interest

increases in different lengths of time. To read this table, find the number of years that the money is on deposit; then look across that row until you come to the column that tells the rate of interest paid. The figure there tells you the amount (principal plus interest) to which each dollar will grow in that length of time. For example, to find out how much every dollar deposited will amount to in 35 years at $2\frac{1}{2}$ per cent compounded semiannually, find the figure that is in the row marked 35 and also in the column headed $2\frac{1}{2}$. This figure is 2.38590; this figure means that in 35 years every dollar deposited will grow to $2.39. Of course $10 will grow to 10 times this amount, or $23.86; $100 will grow to $238.59; and $1000 will grow to $2385.90.

Table 9. THE AMOUNTS TO WHICH EACH DOLLAR INVESTED WILL INCREASE WHEN INTEREST IS COMPOUNDED SEMIANNUALLY

Number of Years	1%	$1\frac{1}{2}$%	2%	$2\frac{1}{2}$%	3%
$\frac{1}{2}$	1.00500	1.00750	1.01000	1.01250	1.01500
1	1.01003	1.01502	1.02010	1.02516	1.03023
$1\frac{1}{2}$	1.01508	1.02263	1.03030	1.03797	1.04568
2	1.02015	1.03029	1.04060	1.05095	1.06136
$2\frac{1}{2}$	1.02525	1.03800	1.05101	1.06408	1.07728
3	1.03038	1.04578	1.06152	1.07738	1.09344
$3\frac{1}{2}$	1.03553	1.05361	1.07214	1.09085	1.10984
4	1.04071	1.06150	1.08286	1.10449	1.12649
$4\frac{1}{2}$	1.04591	1.06945	1.09369	1.11829	1.14339
5	1.05114	1.07745	1.10462	1.13227	1.16054
10	1.10490	1.16092	1.22019	1.28204	1.34686
15	1.16140	1.25083	1.34785	1.45161	1.56308
20	1.22079	1.34772	1.48886	1.64362	1.81402
25	1.28323	1.45310	1.64463	1.86102	2.10524
30	1.34885	1.56459	1.81670	2.10718	2.44322
35	1.41783	1.68577	2.00676	2.38590	2.83546
40	1.49034	1.81804	2.21672	2.70148	3.29066
45	1.56655	1.95909	2.44863	3.05881	3.81895
50	1.64667	2.11108	2.70481	3.46340	4.43205

PROBLEMS

Solve the following problems by using Table 9.

1. Find the amount to which each dollar on deposit will grow at 3 per cent interest compounded semiannually in the following lengths of time:

a. 1 year
b. 3 years 6 months
c. 5 years
d. 20 years

2. Find the amount to which each dollar on deposit will grow at $1\frac{1}{2}$ per cent interest compounded semiannually in the following lengths of time:

a. 4 years 6 months
b. 10 years
c. 15 years
d. 20 years

3. To what amount will \$300 increase in four years if it is invested at $2\frac{1}{2}$ per cent compounded semiannually?

4. Find the amount to which \$500 will grow in 4 years at 2 per cent interest, compounded semiannually.

5. Donald Gray deposited \$250 in a bank that paid $2\frac{1}{2}$ per cent interest per year, payable semiannually. Five years later he withdrew his deposit and the interest on it. How much did he receive?

6. William has a savings account of \$64. How much will this amount to in 10 years at 2 per cent, compounded semiannually?

7. At 1 per cent interest, compounded semiannually, how long will it take for:

a. each dollar on deposit to increase to \$1.16?
b. \$100 to increase to \$110.49?
c. \$400 to increase to \$408.06?
d. \$300 to increase to \$310.66?

8. At 3 per cent interest, compounded semiannually, how long will it take for:

a. each dollar deposited to increase to \$1.81?
b. \$1000 to increase to \$4432.05?
c. \$80 to increase to \$91.47?
d. \$400 to increase to \$457.36?

9. When Harry Orr was born, his father placed $100 in a savings account which has been undisturbed ever since. Harry is now 15 years old, and his bank book shows a balance of $134.79. The interest has been compounded semiannually. At what rate was interest paid on the deposit?

10. Ten years ago, when Helen Cox entered junior high school, her father deposited $100 in a savings account, to remain untouched until she graduated from college. When Helen graduated this year, she received $128.20. The interest had been compounded semiannually. At what rate was interest paid on the account?

Letting the Government Use Your Money

There are two common ways of investing money with the Federal government. One is to have a postal savings account. The other is to buy United States Savings Bonds.

Postal Savings

Anyone ten years old or older may open a postal savings account at any post office. You can buy a postal savings certificate for as little as $1.00. If you have difficulty in saving even a dollar, you may buy postal savings stamps for $.10 or $.25 each. When you have a dollar's worth of postal savings stamps, you may change them for a certificate. You may deposit any number of dollars at a time, until you have invested a total of $2500 in postal savings certificates. You may withdraw money from your postal savings account whenever you wish to do so.

Your certificates draw interest at the rate of 2 per cent per year, except in a few states where state laws fix the rate at 1 per cent. (Stamps do not draw interest.) Interest begins the first day of the month *after* you deposit your money. Interest on postal savings is *simple interest;* it is not added to your deposits. You can get your interest in cash once a year. For example, suppose you buy a $50 postal savings certificate. Your annual interest is $1.00. You can get the dollar by

showing the certificate at the post office. If you don't call for it one year, you get \$2.00 the next year. That is, you get two years' interest on \$50, not one year's interest on \$50 and one year's interest on \$51. Your interest is not compounded.

$$I = P \times r \times t$$
$$\text{First year: } I = \$50 \times .02 \times 1 = \$1.00$$
$$\text{Second year: } I = \$50 \times .02 \times 1 = \$1.00$$

PROBLEMS

Figure the interest called for in these problems at the rate of 2 per cent per year.

1. If a person deposits \$238 in postal savings, how much interest does he receive at the end of one year?

2. James Denton deposited \$175 in postal savings. At the end of four years he collected his interest in cash. How much money did he receive?

3. Mrs. Baker bought a postal savings certificate for \$200 on March 20. If she should withdraw her savings on October 20, how much interest would she get?

4. When Abigail Andrews graduated from eighth grade, her father gave her a \$50 postal savings certificate. Abigail decided that she would collect her interest each July in the form of a \$1 certificate instead of in cash. She did this after her freshman, sophomore, and junior years in high school. The July following her graduation from high school, she presented all her certificates at the post office, and asked for her money plus interest. How much did she receive?

5. Bernard Bates won a \$100 prize in a nation-wide essay contest. He debated whether to open an account in the local savings bank or to put his money in postal savings. He believed that he would need the money in three years, when he would have completed his vocational training. Since the bank paid only $1\frac{1}{2}$ per cent interest per year, compounded semiannually, Bernard bought a \$100 postal savings certificate. Do you think he made the right choice? Show computations to support your answer. (Use Table 9 if you wish.)

United States Savings Bonds

ROBERTS

By buying savings stamps regularly, this girl saves enough money to buy savings bonds.

There are several series of United States Savings Bonds. The most popular of these are the Series E Bonds. When you buy a Series E bond for $18.75, the United States government promises to pay you $25 ten years after the date the bond is issued. The *maturity value* of the bond is $25. In other words, the bond is sold on the *discount* basis. You receive all your interest when the bond matures (comes due). Table 10 shows the amount the buyer must pay for bonds of different denominations and the amount he will receive in ten years.

Series E bonds can be cashed at any time except within the first 60 days after the date of issue. The date of issue is always considered as the first day of the month *in which* you buy the bond.

Table 10. MATURITY VALUES OF UNITED STATES SAVINGS BONDS, SERIES E

Cost of Bonds	*Maturity Value after 10 Years*
$ 18.75	$ 25.00
37.50	50.00
75.00	100.00
150.00	200.00
375.00	500.00
750.00	1000.00

To cash a Series E Bond, take it to a bank. After you have identified yourself, sign the request for payment that is printed on the back of the bond. An official of the bank will then give you your money.

The cash values of a Series E Bond are printed on the back of it. Table 11 shows them for a $25 bond. The cash values (redemption values) for a $50 bond are twice the values for a $25 bond, and the redemption values for a $100 bond are four times the values for a $25 bond.

Table 11. REDEMPTION VALUES OF A $25 UNITED STATES SAVINGS BOND, SERIES E, AT VARIOUS TIMES AFTER DATE OF ISSUE

Period after Issue Date	*Redemption Value During Period*
First ½ year	$18.75
½ to 1 year	18.75
1 to 1½ years	18.87
1½ to 2 years	19.00
2 to 2½ years	19.12
2½ to 3 years	19.25
3 to 3½ years	19.50
3½ to 4 years	19.75
4 to 4½ years	20.00
4½ to 5 years	20.25
5 to 5½ years	20.50
5½ to 6 years	20.75
6 to 6½ years	21.00
6½ to 7 years	21.50
7 to 7½ years	22.00
7½ to 8 years	22.50
8 to 8½ years	23.00
8½ to 9 years	23.50
9 to 9½ years	24.00
9½ to 10 years	24.50

PROBLEMS

Use Table 10 and Table 11 to help you solve these problems.

1. Answer these questions about a $50 Series E bond, held until it matures:

a. What is the principal?
b. What is the amount of interest received?

2. If you were to buy a $25 Series E bond and keep it 10 years:

a. How much money would you lend to the government?
b. How much money would you receive after ten years?

3. Suppose that you found it necessary to cash a $25 Series E bond 3 years and 4 months after you bought it.

a. How much money would you receive?
b. How much interest would you receive?

4. Harry Smith cashed a $50 Series E bond 5 years and 3 months after he bought it.

a. How much money did he receive?
b. How much of the total amount received was interest?

5. Every month for four years, Miles Arnold had $37.50 deducted from his wages for the purchase of United States Savings Bonds.

a. How much money did Mr. Arnold put into bonds?
b. How much money will he receive if he holds all his bonds until they mature?

6. During the five years she worked after graduation, Marcia Flynn had $18.75 deducted from each of her monthly salary checks for the purchase of United States Savings Bonds.

a. How much of her money did Marcia save in this way?
b. How much will she receive if she keeps all the bonds until they mature?

7. In September, William Hawley and Tom Waters each decided to save $75 of the wages they received at the end of the summer. William bought a $100 Savings Bond. Tom bought $75 worth of postal savings certificates. Tom did not collect interest until he withdrew the money.

a. Suppose both boys want their money the following June. How much will each boy receive? (Hint: Remember that Tom's money starts drawing interest October 1.)

b. Suppose both the boys let their money draw interest for ten years. How much more will William receive in interest than Tom?

8. Beth Sanderson bought a $50 bond in December. The same day, Marie Knowlton put $37.50 in a savings bank that pays 2.5 per cent interest, compounded on the first of January and the first of July.

a. Suppose both girls want their money the next August. How much will each receive?

b. Suppose the money of both girls draws interest for ten years. How much more will Beth receive in interest than Marie?

9. For two years Mary Carey bought a $25 Series E bond each month. Then she stopped working, and six months later cashed all her bonds to pay for her trousseau. How much money did she receive?

10. Bill Judson bought a $50 Series E bond every month for three years. Then he lost his job. After three months of odd jobs, he decided to use his savings to open a radio shop. How much money did he get when he cashed his bonds?

Associations for Saving and Lending Money

Millions of people invest their savings by buying *shares* in associations that make a business of lending money. These associations are regulated by State and Federal governments; so the money invested is usually safe. The investors generally receive a higher rate of interest on their money than they can get from bank deposits.

Savings and Loan Associations

Savings and loan associations (called co-operative banks in some places) lend money to persons who want to buy real estate. Money invested in savings and loan associations is

not quite so *liquid* as money invested in savings banks or government bonds; that is, it cannot be withdrawn as quickly. However, most accounts are insured, up to $10,000, by the Federal Savings and Loan Insurance Corporation. Investors receive about 2 or 3 per cent interest annually. This interest is called *dividends.*

A share in a savings and loan association ordinarily costs $100. You can buy a share outright, paying $100 for it, then the share is called a *full-paid share.* Or you can make payments of as little as $.50 or $1.00 until a share is purchased; that is, you can buy an *installment share.* Sometimes these payments are made weekly or monthly; sometimes they are made at irregular intervals. A third way to buy a share in a savings and loan association is on the discount basis, much as you buy a Series E Savings Bond. You make a single payment, say $80, for a share and allow the interest to accumulate until the share is worth $100. This kind of share is called a *prepaid share.*

PROBLEMS

1. Mr. Snyder owns six full-paid shares of $100 each in a savings and loan association which pays dividends at the rate of 2 per cent a year. Find the annual dividends on Mr. Snyder's shares.

2. What annual income will Mr. Thompson receive on forty full-paid shares of $100 each in a savings and loan association if the association pays dividends at the rate of $2\frac{1}{2}$%?

3. Mr. Wheeler paid $5.00 each month for 14 years to a savings and loan association. At the end of that time he had received ten $100 shares.

a. What was the total amount he paid?

b. How much did the value of his shares exceed the amount he paid?

4. Mr. Skidmore receives $120 annually as dividends from a savings and loan association which has a dividend rate of 3 per cent per year. How many $100 shares does Mr. Skidmore own?

a. Suppose both boys want their money the following June. How much will each boy receive? (Hint: Remember that Tom's money starts drawing interest October 1.)

b. Suppose both the boys let their money draw interest for ten years. How much more will William receive in interest than Tom?

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a. What was the total amount he paid?

b. How much did the value of his shares exceed the amount he paid?

4. Mr. Skidmore receives $120 annually as dividends from a savings and loan association which has a dividend rate of 3 per cent per year. How many $100 shares does Mr. Skidmore own?

5. Mrs. Woolman receives $75 a year as dividends from her savings and loan association shares. How many $100 shares does she own if the association has a dividend rate of 2.5 per cent per year?

Credit Unions

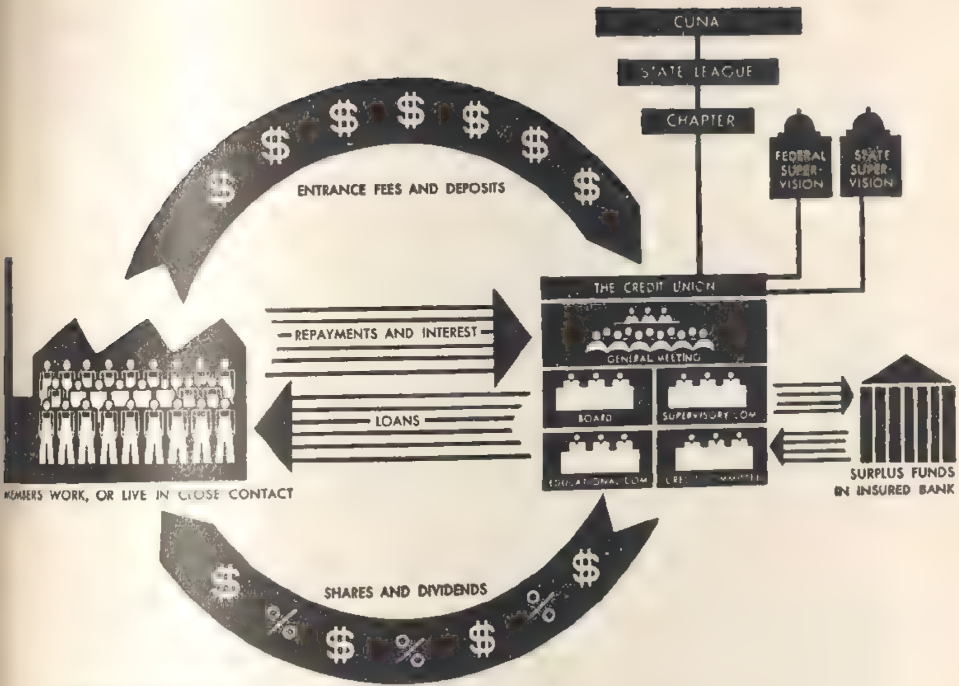
A good way to make your money work for you is to join a credit union. A credit union is usually made up of persons who have similar interests, such as farmers, teachers, workers in a store or factory, or members of a lodge, and operates under a State or Federal charter. When you join a credit union, you pay a small entrance fee (usually $.25 or $.50) and buy shares at $5 or $10 a share. The money you and other members pay for your shares is used to make small loans to members in need of cash. These members pay interest on the money they borrow, and this interest makes up the earnings of the credit union. From time to time (generally once a year) the earnings, less expenses, are divided among the members according to the number of shares they own; that is, a dividend is declared. Of course, the dividend rate or interest rate varies from year to year, according to the earnings of the union. Usually shares purchased any time during a month begin to draw interest the first day of the following month.

PROBLEMS

1. At the beginning of the calendar year, Mr. Meyers owned 30 shares in a credit union. Each share cost him $5. He bought no stock that year. The following January, the credit union declared a 3 per cent dividend. What was the amount of the dividends Mr. Meyer received?

2. Mr. Arnold owned 50 shares in a credit union for an entire year. Each share cost him $10. How much did he receive if a 4% dividend was declared at the end of the year?

3. Nancy Rolls joined a teachers' credit union during September and bought one $5 share on the tenth of each month. On February 1 the credit union declared a 4% dividend. How much did Miss Rolls receive in dividends?



PICTOGRAPH CORPORATION

Credit union members deposit savings and receive dividends (curved arrows). Their credit union lends members money, which they repay at low rates of interest (large straight arrows). The credit union is a chapter of a state league and the Credit Union National Association. It operates under Federal and State supervision. It keeps its funds in a bank and withdraws them as necessary (small straight arrows).

4. Jim Lovett joined the Athletic Club Credit Union during January, buying one $5 share on the fifteenth of each month during the year. The union declared a 3 per cent dividend on July 1. How much money did Jim receive?

5. When Frances Wells took a job with the Dumore Manufacturing Company, she found that she could join an employees' credit union. She withdrew $125 from her savings account in a bank that paid $1\frac{1}{2}$ per cent interest, compounded semiannually. She used the money to buy credit-union shares. One year later, she received a 5 per cent dividend on her shares.

a. How much did Frances receive on her credit-union shares?

b. How much would her interest have amounted to if she had left her money in the bank?

6. Paul Rawson belonged to a Grange that started a credit union. He took $275 from his savings account and bought shares in the credit union. His bank paid 2 per cent interest, compounded semiannually. At the end of its first year the credit union declared a dividend of $4\frac{1}{2}$ per cent.

a. How much did Mr. Rawson receive on his credit-union shares?

b. How much would his interest have amounted to if he had left his money in the bank?

7. While Bert Holmes was a member of the Junior Executives' Credit Union, he received dividends as follows:

First year	6 shares	4 per cent
Second year	18 shares	$5\frac{1}{2}$ per cent
Third year	36 shares	$4\frac{1}{2}$ per cent
Fourth year	60 shares	4 per cent

He paid $10 for each share. What was the total amount received as dividends?

8. Over a period of four years, Mr. Lucas received dividends on credit-union stock he held as follows:

First year	12 shares	3 per cent
Second year	24 shares	5 per cent
Third year	36 shares	$3\frac{1}{2}$ per cent
Fourth year	48 shares	4 per cent

Each share of stock cost $5. What was the total amount that Mr. Lucas received as dividends?

9. Richard Barker owned 10 shares of credit-union stock for 8 months and 6 shares for 2 months. A dividend of 4 per cent was declared. Each share cost $10. Find the amount Richard received. (*Hint:* Find the amount of the dividend on one share for one month.)

10. Mr. Brown drew dividends of 4 per cent on the following credit-union shares:

7 shares for 8 months
9 shares for 6 months
10 shares for 5 months

Find the total amount of Mr. Brown's dividends if the stock is worth $5 a share. (*Hint:* Find the amount of the dividend on one share of stock for one month.)

Stocks and Bonds

Persons who are quite sure that they will not have to use their savings for some time often invest them in stocks and bonds. Stocks and bonds are bought and sold in markets called *stock exchanges.* The transactions are handled by agents known as *brokers,* who charge a commission called *brokerage* for their services.

Investing Money in Bonds

When you buy a bond, you lend your money to the corporation or government agency issuing the bond. A bond is a promise to pay back the money loaned on a certain date and to pay interest on it at stated times. The rate of interest is usually given on the bond. Some bonds are guaranteed by property; other bonds are guaranteed only by the reputation of the issuer.

Most corporation bonds are issued at $1000. For example, if a corporation needs to borrow $10,000,000, it may issue 10,000 bonds each with a *face value* (or *par value*) of $1000.

Suppose you own a $1000 bond that pays 4 per cent interest and will come due in 1968. You will receive $1000 in 1968. Until then, twice each year, you will clip a coupon from the bond and send it to the corporation

A bond owner clips coupons and sends them to the corporation issuing the bond. In return, the owner receives interest.

ROBERTS

that issued the bond. Upon receipt of the coupon, the corporation will send you your interest, which will amount to $20 each six months.

$$I = P \times r \times t$$
$$I = \$1000 \times .04 \times \tfrac{6}{12} = \$20$$

The prices of bonds, like other prices, change from time to time. Sometimes you can buy a $1000 bond for $900. The market price of a bond does not affect its face value. Even if you paid only $900 for your $1000 bond, you would still receive $40 interest a year, and when the bond comes due you would get $1000 from the corporation that issued it.

Bond prices are listed in the daily newspapers. Here is a sample:

Ill Central $4\frac{3}{4}$s '66 $84\frac{1}{2}$

This sample means that Illinois Central Railroad bonds paying $4\frac{3}{4}$ per cent interest and coming due in 1966 sold at $84\frac{1}{2}$ per cent of the face value.

Suppose that Mr. Irving decided to buy one of these bonds. It would cost him $84\frac{1}{2}$ per cent of $1000, or $845. In 1966 he would receive $1000 from the Illinois Central Railroad. His profit at that time would be the difference between $1000 and $845, or $155.

Meanwhile he would receive interest on $1000 at $4\frac{3}{4}$ per cent. Each year his interest would amount to .0475 times $1000, or $47.50. That is, he would receive a return of $47.50 a year on an investment of $845. His return is 5.6 per cent of the amount he invested.

$$47.50 \div 845 = .056 = 5.6\%$$

This per cent is called the *current yield.* Mr. Irving's current yield on his investment is 5.6 per cent.

PROBLEMS

1. Mr. Hinman bought ten $1000 bonds of the Standard Oil Company of New Jersey, quoted as follows:

Stand Oil N J 3s '61 $104\frac{3}{8}$

a. How much money did he invest?
b. When will his bonds come due?

2. Mr. Goldman bought five $1000 bonds of the Goodrich Rubber Company when the quotation was as follows:

Goodrich $4\frac{1}{2}$s '66 $103\frac{1}{4}$

a. How much did his bonds cost him, exclusive of brokerage?
b. When will these bonds come due?

3. Mrs. French bought a $1000 bond listed as follows:

Nat Dairy $2\frac{3}{4}$s '70 $98\frac{3}{8}$

a. What amount of money will she be paid as interest each year?
b. What principal did she invest?
c. What is the current yield on her bond?
d. What profit will she receive on her money in 1970?

4. Mr. Eaton bought a $1000 bond listed as follows:

Am Tel & Tel $2\frac{7}{8}$s '87 $95\frac{7}{8}$

a. What interest will the American Telephone and Telegraph Company pay Mr. Eaton annually on this bond?
b. How much money did Mr. Eaton actually lend to the company?
c. What is the current yield on the bond?
d. If Mr. Eaton (or his heir) holds the bond until 1987, what will be his profit?

5. Mrs. Donaldson has twenty Consolidated Edison Company bonds which she bought when they were listed as follows:

Cons Edison $2\frac{3}{4}$s '68 $101\frac{1}{4}$

She sends in her coupons regularly every six months.

a. What is the size of each interest check that she receives from the Consolidated Edison Company?
b. What is the current yield on these bonds?

Investing Money in Stocks

The amount of money people invest in a corporation is called the *capital stock* of the corporation. The capital stock is divided into equal parts called *shares*. Each share is usually $10, $25,

$50, or $100. For example, if the capital stock of a company is $5,000,000, the company may issue 50,000 shares of stock each with a value of $100.

When you buy a share of stock, you become a part owner of the property of the corporation, or a *stockholder*. You are entitled to your part of the earnings of the corporation, which you receive as dividends. Of course, you take some risk. Perhaps the corporation will not earn any money. If it should fail, bond owners will be paid off before stockholders.

Dividends are paid on the shares when the directors of a corporation decide that they should be. The amount of a dividend may be expressed in dollars per share, or it may be expressed as a per cent of the stated value of the share.

There are two kinds of stock: common and preferred. Owners of preferred stock receive dividends at a fixed rate, say 4 per cent. Whenever a dividend is declared, they receive this rate of interest on their investment; they never receive less and they never receive more. Owners of common stock, on the other hand, receive dividends at varying rates. These rates may be lower than those received by the owners of preferred stock, or they may be considerably higher.

The selling prices of stocks are published in the daily newspapers. They are expressed in terms of dollars and fractions of a dollar; thus a price of $78.25 would be reported as $78\frac{1}{4}$. Here are some "stock quotations" for selected common stocks on a certain day:

Sales	*Stock*	*High*	*Low*	*Close*
11,000	American Chicle 4	$151\frac{3}{4}$	151	$151\frac{3}{4}$
3,200	Atlantic Refining $1\frac{1}{2}$	$39\frac{3}{8}$	$38\frac{1}{8}$	39
2,100	Eastman Kodak 1.40	$45\frac{1}{2}$	$44\frac{3}{4}$	$44\frac{3}{4}$
2,700	Loew's Inc. $1\frac{1}{2}$	23	$22\frac{3}{4}$	23
1,500	Standard Brands 2	$29\frac{3}{4}$	$29\frac{1}{4}$	$29\frac{5}{8}$

The second quotation shows that 3200 shares of Atlantic Refining Company stock were sold that day. The figure immediately after the name of the stock indicates the rate at which the company declared dividends. Atlantic Refining paid dividends of $1.50 per share. The highest price that

[…]SY, MERRILL LYNCH, PIERCE, FENNER, AND BEANE

This exhibit was set up at the Iowa State Fair so that those interested could learn how stocks were being bought and sold.

anyone paid for this stock on the day reported was $39.375 per share, and the lowest price was $38.125. At the close of the business day, the price was $39.

To save space, newspapers abbreviate the names of stocks and the word "preferred," when used. For example, Atlantic Refining Company preferred stock is listed as *Atl Ref pf 4*.

PROBLEMS

1. What information about Eastman Kodak stock can you get from the quotations on page 314?

2. Answer these questions about Standard Brands stock for the day the prices on page 314 were quoted:

a. How many shares were sold?
b. What was the highest price received?
c. What was the lowest price that day?
d. How much dividend per share does Standard Brands pay?

e. What was the difference between the highest and the lowest price for the day?

f. What was the price of the stock when the market closed?

3. Find the cost, not including brokerage, of 20 shares of American Chicle stock if bought at the low price in the quotations on page 314.

4. Find the cost, exclusive of brokerage, of 50 shares of Loew's Incorporated, if bought just as the market closed on the day reported on page 314.

5. Find the cost of 30 shares of Atlantic Refining stock, including brokerage of $\$.22\frac{1}{4}$ per share, if purchased at $39\frac{3}{8}$.

6. Find the cost of 40 shares of stock at $85\frac{3}{8}$, including brokerage of $.34 a share.

7. Mr. Bowman owns 23 shares of stock that pays an annual dividend of $2.75 a share. Find his total annual income from this stock.

8. Grace Smith owns 32 shares of Loew's Incorporated stock that pays an annual dividend of $1.50 a share. Find her total annual dividend from this stock.

9. Mr. Richards owns 30 shares of stock that cost him $112.50 a share. The annual dividend is $4.50 per share.

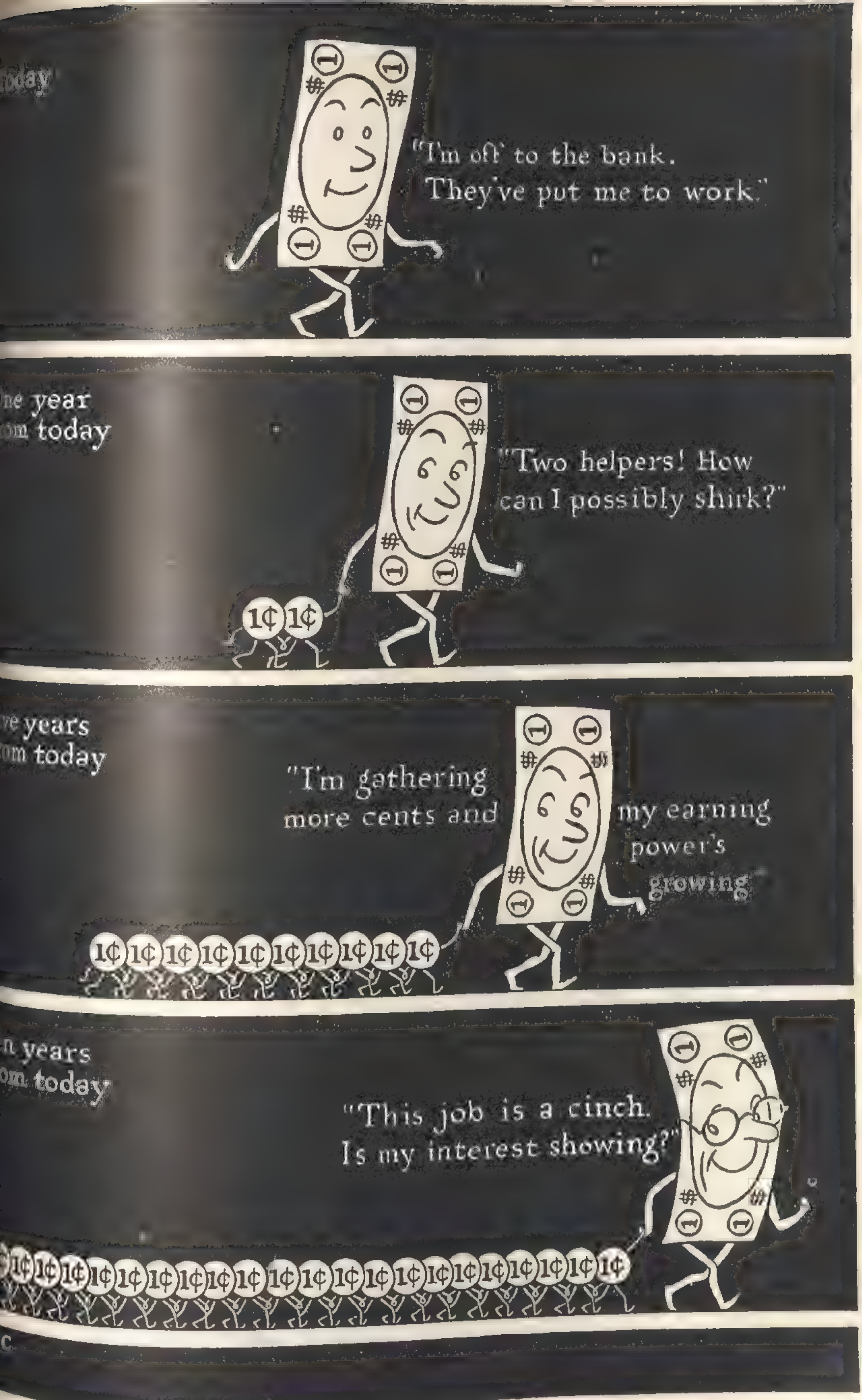
a. What amount does Mr. Richards receive annually as dividend on this stock?

b. What per cent of the cost of the stock is the annual dividend?

10. Mr. Baker owns 40 shares of Best Foods stock that he purchased at $24 a share. The annual rate of dividend on this stock is $1.20 per share.

a. What amount does Mr. Baker receive annually as dividend on this stock?

b. What per cent of the cost of the stock is the annual dividend?


oday
"I'm off to the bank. They've put me to work."
ne year
om today
"Two helpers! How can I possibly shirk?"
e years
om today
"I'm gathering more cents and my earning power's growing."
n years
om today
"This job is a cinch. Is my interest showing?"

What You Have Learned in This Chapter

1. To answer these questions about investments:

   Will my money be safe?
   What rate of interest will I receive?
   How easily can I get my money back?

   (See Table 12.)
2. To figure interest on bank savings accounts and on postal savings
3. To understand the nature of Series E Savings Bonds
4. To understand something of the way in which associations for saving money operate
5. To understand the difference between stocks and bonds
6. To read newspaper quotations of stocks and bonds
7. To use these terms: *principal, compound interest, simple interest, maturity value, redemption value, share, dividend, par value, current yield*

Two ways of investing money are suggested by these pictures. At the left is a scene in a stockbroker's office; at the right a girl shows her father her savings account book.

GENDREAU

Table 12. COMPARISON OF SOME KINDS OF INVESTMENT

Investment	*Will my money be safe?*	*What rate of interest will I receive?*	*How easily can I get my money back?*
Savings Bank	Operations governed by law and carefully supervised. Most accounts insured by Federal Deposit Insurance Corporation, up to $10,000.	Reasonable, though not large. Usually from 1 to 3%, compounded semiannually.	Can usually be withdrawn at any time.
Postal Savings	Repayment promised by U. S. government.	2%, simple interest.	Can be withdrawn at any time.
U. S. Savings Bonds Series E	Repayment promised by U. S. government.	Equivalent to 2.9% compounded annually.	Bonds can be cashed at any time after 60 days from date of issue.
Savings and Loan Association	Governed by law and carefully supervised. Accounts up to $10,000 insured by Federal Savings and Loan Insurance Corporation (in associations that are members).	Slightly higher than in a savings bank. Usually from 2 to 3%.	Since money is invested in long-term real estate loans, it cannot be withdrawn quite as readily as from a savings bank.
Credit Union	Operations examined annually by State or Federal authorities.	Usually higher than that paid by a savings bank.	Can be withdrawn at any time.
Bonds	Secured by mortgage on property of the corporation or by reputation.	Usually higher than on U. S. savings bonds. Fixed rate.	If listed with organized exchange they can usually be sold promptly.
Preferred Stock	No security.	Usually higher than on bonds. Fixed rate. Paid only if any income remains after payment has been made on bonds.	Can usually be sold if listed on an organized exchange.
Common Stock	No security.	May be very high or none whatever. Depends on earnings of company and on general market conditions.	Can usually be sold at current market price. Price varies depending on business conditions and dividends earned.

Review Test on Investment

1. After the interest due on January 1 had been added to his bank balance, Allen Harms had $187.44 in his savings account. He made no deposits until the following August. His bank pays $1\frac{1}{2}$ per cent interest, compounded on January 1 and July 1. How much money did he have in his account on July 31?

2. The Riverside Savings Bank pays 2 per cent interest on accounts, compounded on January 1 and July 1. Jean Griffiths opened an account by depositing $50 on December 27. She deposited $25 on March 15 and again on May 15. What was her balance after the July interest had been added?

3. Ronald McKenzie deposited $137 in postal savings which draw simple interest at 2 per cent. How much was the interest on Ronald's deposit for one year?

4. Walter Day bought a $25 Series E United States Savings Bond at the end of each six months for three years. How much did all these bonds cost him?

5. Barbara Bowen invested $93.75 in Series E Savings Bonds. How much money will she receive when the bonds mature? (*Hint:* She bought 5 bonds.)

6. In the Vendome Building and Loan Association, 50 cents a month for a period of fourteen years will pay for one $100 share. Mr. Lowe purchased shares in the association paying $10 a month for fourteen years.

a. How many shares did Mr. Lowe buy?

b. What amount did Mr. Lowe actually pay the association?

c. What was the difference between the amount Mr. Lowe paid and the total value of his shares?

7. Robert Fox joined the Video Amateurs' Credit Union during June, buying one $10 share. Toward the end of each month from then on, he bought one $10 share. On December 1 the credit union declared a 6 per cent dividend. Robert received a dividend on all his shares but the one most recently purchased. What was the amount of his dividend?

8. Mr. Cochrane bought a $1000 bond when the quotation was as follows:

Sou Pac $4\frac{1}{2}$s '81 $93\frac{3}{4}$

a. How much money did he invest?

b. How much money will he receive as interest each year?

c. What per cent of the amount invested does he receive as interest; that is, what is the current yield on his bond?

d. When will the bond come due?

e. What profit will Mr. Cochrane receive on his investment, in addition to interest?

9. What information can you obtain from this quotation:

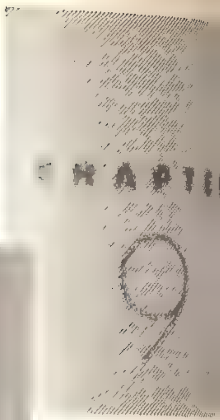
Sales	*Stock*	*High*	*Low*	*Close*
5000	U S Steel pf 7	$79\frac{5}{8}$	$78\frac{5}{8}$	$79\frac{1}{4}$

10. Mrs. Blake bought 50 shares of United States Gypsum Company stock at $101\frac{1}{2}$. The dividend last year was 3 per cent.

a. How much did Mrs. Blake pay for the stock?

b. What annual income may she expect from it?

How do you rate?	Excellent	Good	Fair	Poor
	9–10	7–8	5–6	4 or less



BLACK STAR

1. Find out what kinds of insurance the head of your family carries. How were these policies chosen?
2. Write to the Institute of Life Insurance (60 East 42 Street, New York 17) for pamphlets telling about life insurance.
3. Investigate the provisions of the Social Security Act. The World Almanac is one source of information you can use.
4. Ask a number of automobile owners what kinds of insurance they have on their cars. Find out why they carry the insurance they do.
5. Make a survey of a group of students to learn how many have insurance in some form.

INSURANCE FOR SECURITY

TROUBLES COME TO EVERY FAMILY. A family member may die; crippling illness may strike; fire may destroy the home; the family car may be the means of injuring a pedestrian. In order that financial problems may not be added to grief and worry in situations like these, far-sighted persons buy insurance — life insurance, health and accident insurance, fire and theft insurance, public-liability insurance. Thus they provide security for themselves and their families.

Insurance is really a plan for sharing financial risks. For example, suppose you want to insure yourself against loss of your automobile by theft. You pay an insurance company a few dollars each year. In return, the insurance company promises to repay your loss if your car should be stolen. Many other car-owners also buy theft insurance from that insurance company. The chances are that only a few of all the insured automobiles will be stolen. The owners of these stolen automobiles will be repaid from the money that all the insured persons have paid the company. No one will bear a heavy loss.

Life Insurance

When a person buys life insurance, he pays a stated sum of money to an insurance company at regular intervals. The company agrees that, when he dies, a fixed amount will be paid to a person he has named.

There are many special terms used in referring to insurance. Here is a list of some of them:

policy: the agreement between the insured person and his insurance company

policy-holder: the insured person; the one who holds the policy

beneficiary: the person named to receive money from the company; the one who benefits from the policy

face of the policy: the amount the beneficiary is to receive

annual premium: the amount the policy-holder pays to the insurance company each year

A person buys life insurance in order to protect others from financial worry in case of his death. Naturally, the amount of protection he wants to give others changes as he grows older. A single man may not need as much insurance as a married man; a childless woman may not need as much insurance as the mother of young children. Because a person's needs change, he does not buy life insurance "once and for all." But he is wise if he starts buying life insurance early in life. The annual premium is less for a young person than for an older person. For this reason, many young people buy insurance policies as soon as they begin to earn money.

But, you may say, suppose I lose my job and can't keep on paying premiums. Do I lose all the money I have paid the insurance company? No, you do not. Ordinary life insurance policies have *cash value.* If you cannot continue to pay your premiums, you may turn in your policy for cash. Of course, you lose some money if you do this, and you defeat the purpose for which you bought insurance in the first place. So insurance companies have plans by which policy-holders may be tided over periods of hard luck. You will learn about these plans on pages 332–335.

Cost in Relation to Age

The amount of the premium depends on the policy-holder's age at the time he buys his policy. For example, Don Colson

bought a $1000 life insurance policy when he was 15 years old. The annual premium is $14.25. If he should die, his beneficiary would receive $1000.

Don is 20 now, but his premium on that policy is still $14.25. Wally Ruckert is also 20. He pays an annual premium of $15.36 on the $1000 policy he holds. He bought it when he was 18 years old.

Table 13. ANNUAL PREMIUM AND INSTALLMENT PAYMENTS PER $1000 ORDINARY LIFE INSURANCE AT AGES FROM 1 YEAR TO 25 YEARS

Age Nearest Birthday	*Annual Premium*	*Semi-Annual Installment*	*Quarterly Installment*	*Monthly Installment*
1	$10.86	$5.54	$2.82	$ .96
2	10.93	5.57	2.84	.97
3	11.08	5.65	2.88	.98
4	11.25	5.74	2.93	.99
5	11.45	5.84	2.98	1.01
6	11.66	5.95	3.03	1.03
7	11.89	6.06	3.09	1.05
8	12.13	6.19	3.15	1.07
9	12.38	6.31	3.22	1.09
10	12.66	6.46	3.29	1.12
11	12.95	6.60	3.37	1.14
12	13.25	6.76	3.45	1.17
13	13.57	6.92	3.53	1.20
14	13.91	7.09	3.62	1.23
15	14.25	7.27	3.71	1.26
16	14.60	7.45	3.80	1.29
17	14.98	7.64	3.89	1.32
18	15.36	7.83	3.99	1.36
19	15.77	8.04	4.10	1.39
20	16.19	8.26	4.21	1.43
21	16.62	8.48	4.32	1.47
22	17.08	8.71	4.44	1.51
23	17.55	8.95	4.56	1.55
24	18.04	9.20	4.69	1.59
25	18.56	9.47	4.83	1.64

Table 13 shows typical premiums at different ages. Notice that the premium is stated in dollars per $1000 of insurance. A $2000 policy costs just twice as much as a $1000 policy, and a $500 policy costs just half as much as a $1000 policy. If a boy of 16 should buy a policy from the company that supplied this table, he would pay an annual premium of $14.60 per $1000 of insurance.

The annual premium may be paid in installments. Instead of paying $14.60 per $1000 annually, a boy of 16 may pay $7.45 twice a year. Or he may pay $3.80 four times a year, or $1.29 each month.

PROBLEMS

Refer to Table 13 for information as you solve these problems.

1. Jack Austin bought a $1000 life insurance policy when he was 15. When he was 20, he bought another $1000 policy from the same company.

a. What is his annual premium on the policy he bought when he was 15?

b. What is his annual premium on the policy he bought when he was 20?

c. What amount does he pay the insurance company each year?

d. If both policies have the same beneficiary, how much would the beneficiary receive if Jack should die?

2. Frank Kurtz bought $1000 worth of insurance when he was 17. He pays his premium in monthly installments. How much more does he pay in a year than he would pay if he had chosen to make a single annual payment?

3. Albert French has a $1000 life insurance policy that his father bought for him on his first birthday. Albert is 19 now.

a. What annual premium does Albert pay on his policy?

b. How much money has the insurance company received on account of Albert's policy? (*Hint:* 19 premiums have been paid.)

4. Mr. and Mrs. Jackson have four children. Their income is small, and their expenses high. When a small child in the

neighborhood died recently, the Jacksons realized that they would be unable to pay the cost of a last illness and burial if a similar tragedy should come to them. So they decided to insure the life of each of their children for $1000. The children's ages are 6, 4, 3, and 1. What monthly payment will the Jacksons have to make on this insurance?

5. George Ryan, who was killed in an automobile accident at the age of 30, had a $3000 life insurance policy bought at the age of 18. He had paid his premiums on an annual basis.

a. How much money had he paid the insurance company? (He had paid 13 premiums.)

b. How much money did his beneficiary receive?

c. How much more did the insurance company pay the beneficiary than it had received from the policy-holder?

Lifetime Protection

The table you have been using (Table 13) deals with the kind of insurance called *straight whole life* insurance. (Often it is referred to as "ordinary life" or "straight life.") It provides protection during the *whole life* of the policy-holder. And the policy-holder pays premiums during his whole life.

Although almost everyone wants his life insurance to be in force during his whole life, many persons want to stop paying premiums when they grow older. At the age of 65, for example, they may no longer be earning money; so they want to have as few expenses as possible in their old age. For this reason, insurance companies sell a form of whole life insurance called *life paid-up at age 65*. The policy-holder pays premiums only until he is 65 years old. However, he is insured not only until he is 65, but for the rest of his life as well.

The premiums on "life paid-up at age 65" are, as you would expect, a little higher than the premiums on straight whole life. A fifteen-year-old boy who takes out a straight whole life policy from a certain company has an annual premium of $14.25 per $1000 (see Table 13); a fifteen-year-old boy who takes out a whole life policy paid-up at 65 from the same company pays an annual premium of $15.02 per $1000.

Another form of insurance that provides lifetime protection is called *limited-payment whole life.* A person who buys this kind of insurance usually makes twenty annual payments to his insurance company, and in return he receives life insurance protection during his whole life. Of course, his premiums are comparatively high. The people who buy limited-payment whole life policies are those who have a high earning power while they are young; for example, professional baseball players.

PROBLEMS

1. Bob Keller, who is 20 years old, wants to buy a whole life policy with a face value of $3000. He finds that the annual premium on a straight whole life policy is $16.19 per $1000, while the annual premium on a whole life policy paid-up at age 65 is $17.27 per $1000.

a. If Bob should buy the straight whole life policy, what would his annual premium be?

b. If Bob should buy the policy paid-up at age 65, what would his annual premium be?

2. At the age of 25, Mr. Phelps bought a $4000 twenty-payment whole life policy. He pays an annual premium of $26.29 per $1000. If he completes the payments on this policy, how much will it have cost him?

3. Mr. Weber purchased a $5000 twenty-payment whole life policy when he was 30 years old. The annual premium was $28.12 per $1000. Mr. Weber is now 50 years old, and has finished paying for the policy. How much did it cost him?

4. Records kept by insurance companies show that the average man 20 years old may expect to live to the age of 66. Dick Oliver, who is 20, is considering the purchase of a $5000 whole life policy. He finds that his annual premium on a straight whole life policy would be $14.63 per $1000. He also learns that his annual premium on a twenty-payment whole life policy would be $25.65 per $1000.

a. If Dick should live to age 66, how much would he pay for a $5000 straight whole life policy? (47 premiums)

b. If Dick should live to be at least 40 years old, how much would he pay for a $5000 twenty-payment whole life policy?

DEVANEY

When you buy life insurance, it is well to discuss your needs and expectations with a life insurance expert.

5. Records show that at the age of 50 a man can expect to live 21 years longer. Mr. Manning, who is 50, wants to buy an additional $6000 life insurance policy. On a straight whole life policy, he would have to pay an annual premium of $39.75 per $1000; on a twenty-payment whole life policy, his annual premium would be $47.07 per $1000.

a. If Mr. Manning should live to age 72, how much would he pay for a $6000 straight whole life policy? (22 premiums)

b. If Mr. Manning should live to the age of 70, how much would he pay for a $6000 twenty-payment whole life policy?

Endowment Policies

Another form of life insurance is *endowment* insurance. An endowment policy has two chief provisions:

(1) If the policy-holder dies within a stated time, the face of the policy is paid to his beneficiary.

(2) If the policy-holder does not die within the stated time, the face of the policy is paid to him, and he is no longer insured.

One kind of endowment policy is called *endowment at age 65*. Mr. Wilkins bought a $5000 policy of this sort when he was a young man of 18. He paid an annual premium of $18.23 per $1000. If he had died before reaching 65, his beneficiary would have received $5000. As Mr. Wilkins did not die, the insurance company paid him $5000 when he reached 65.

Another kind of endowment policy is the *twenty-year endowment policy*. Helen Johnson, who is 17, has just bought a $1000 policy of this sort, arranging to pay her premiums in

monthly installments. For the next twenty years, she will make a monthly payment of $4.05 to her insurance company. When she is 37, her policy will *mature*, and she will receive $1000 from the insurance company. However, if she should die during those years, her beneficiary will receive $1000 at the time of her death.

Table 14. ANNUAL PREMIUM AND INSTALLMENT PAYMENTS PER $1000 TWENTY-YEAR ENDOWMENT INSURANCE AT AGES FROM 1 YEAR TO 25 YEARS

Age Nearest Birthday	*Annual Premium*	*Semi-Annual Installment*	*Quarterly Installment*	*Monthly Installment*
1	$46.08	$23.50	$11.98	$4.06
2	45.86	23.39	11.92	4.04
3	45.74	23.33	11.89	4.03
4	45.66	23.29	11.87	4.02
5	45.62	23.27	11.86	4.02
6	45.58	23.25	11.85	4.02
7	45.56	23.24	11.85	4.01
8	45.55	23.23	11.84	4.01
9	45.56	23.24	11.85	4.01
10	45.57	23.24	11.85	4.02
11	45.60	23.26	11.86	4.02
12	45.65	23.28	11.87	4.02
13	45.70	23.31	11.88	4.03
14	45.76	23.34	11.90	4.03
15	45.80	23.36	11.91	4.04
16	45.87	23.39	11.93	4.04
17	45.92	23.42	11.94	4.05
18	45.99	23.45	11.96	4.05
19	46.07	23.50	11.98	4.06
20	46.14	23.53	12.00	4.07
21	46.23	23.58	12.02	4.07
22	46.32	23.62	12.04	4.08
23	46.42	23.67	12.07	4.09
24	46.53	23.73	12.10	4.10
25	46.65	23.79	12.13	4.11

An endowment policy, like a whole life policy, has a cash value. The premiums of an endowment policy are higher than those of a whole life policy with the same face value, because the endowment policy is designed to help the policyholder save money. Table 14 shows the premiums for a twenty-year endowment policy. Because it was prepared by the same company as Table 13, you can use it to compare the premiums for a straight whole life policy with those for a twenty-year endowment policy.

PROBLEMS

In solving these problems, refer to Table 14 as necessary.

1. Susan Bailey is 20 years old. She decides to buy a twenty-year endowment policy for $5000, paying the premiums in monthly installments.

a. How much will each monthly installment be?

b. How much will Susan have paid the insurance company by the time her policy matures?

c. How much will she receive from the insurance company when she is 40?

d. If Susan should die when she is 25, how much will her beneficiary receive from the insurance company?

2. Harold Freeman is 25. He would like to insure his life for $10,000. He learns that he can buy the kind of policy called endowment at age 65 by making a monthly payment of $2.00 per $1000. Straight whole life insurance would require a monthly payment of $1.64 per $1000. He decides to buy the endowment policy for $10,000.

a. If Harold lives until he is 65, how much will he have paid the insurance company? (480 premiums)

b. If Harold had decided to buy the straight whole life policy, how much would he have paid the insurance company by the time he was 65?

3. When Jim Weeks was 1 year old, his father took out a twenty-year endowment policy for him. When Jim was 21, his father presented him with the matured policy for $3000. What annual premium had Mr. Weeks paid?

BLACK STAR

Because his father took out an endowment policy before this young man was born, he has little difficulty paying for his college education.

4. William Brown, aged 25, thinks that the surest way for him to save $5000 is to buy a twenty-year endowment life insurance policy.

a. What is the annual cost of his policy?

b. How much will his beneficiary receive if he should die at the age of 35?

c. How much will he receive at the age of 45?

5. Mr. Kenyon, aged 30, wishes to save $8000 and be insured while saving it. He therefore buys an $8000 twenty-year endowment policy, on which the annual premium is $47.43 per $1000.

a. How much does he pay on his policy each year?

b. How much will his beneficiary receive if he should die at 35?

c. How much will Mr. Kenyon receive from the insurance company at the age of 50?

If Premiums Are Not Paid

Suppose that an emergency arises in a policy-holder's financial affairs, and he finds himself unable to pay a premium when it is due. In such a situation, his insurance company may lend him the money to pay the premium. If he should die before he has paid back the loan, the insurance company will deduct the amount of the loan from the face of the policy and will pay the rest of the insurance to the beneficiary.

Now suppose the policy-holder doesn't see any chance of being able to pay his premiums for a long time. Then he may do one of three things:

(1) He may draw out the cash value of the policy. When he does so, of course, he is no longer insured.

(2) He may use the cash value to buy a *paid-up policy.* The insurance company will issue him a new policy with a smaller face value, on which he need pay no more premiums.

(3) He may use the cash value to buy an *extended term policy.* The insurance company will issue a new policy with the same face value, but it will protect him only for a term of years, not for his whole life.

Table 15 shows the cash value per $1000 of a certain twenty-payment whole life policy five years after it was purchased. It also tells how large a paid-up policy this cash value will buy, and how long a period of extended term insurance it will buy.

Table 15. CASH VALUE PER $1000, PAID-UP INSURANCE VALUE PER $1000, AND PERIOD OF EXTENDED INSURANCE: TWENTY-PAYMENT WHOLE LIFE POLICY FIVE YEARS AFTER PURCHASE AT AGES 20 TO 50.

Age at Purchase	*Cash Value per $1000*	*Paid-Up Insurance Value per $1000*	*Period of Extended Insurance*
20	$ 84	$226	23 years 69 days
25	95	230	20 years 209 days
30	107	234	17 years 307 days
35	118	236	15 years 38 days
40	130	236	12 years 167 days
45	142	236	10 years
50	153	234	7 years 289 days

The first row of the table gives this information for a policy bought at the age of 20. Five years later, it has a cash value of $84 per $1000. That is, if the face of the policy is $1000, the cash value is $84. The policy-holder may take $84 and give up his insurance, if he wishes to. He would be making the first of the choices listed above (number 1, page 332).

The next column in this row shows what his policy is worth in paid-up insurance: $226 per $1000. If the face of the policy

is $1000, its value in paid-up insurance is $226. The policyholder may take a new policy worth $226, on which he need pay no more premiums. His would be choice number 2.

The last column in this row shows how long he can be insured for the face of his policy (whether it is $1000 or some other amount) without paying any more premiums. He can be insured for 23 years and 69 days without paying premiums. At the end of that time, he is no longer insured. If the policyholder decided on this plan, he would be making choice number 3.

Notice that Table 15 refers only to the values of a twenty-payment whole life policy at the end of five years. Insurance companies have worked out similar tables for other kinds of policies and for other periods of time.

PROBLEMS

Refer to Table 15 as necessary.

1. When Chet Arthur was 20 years old, he bought a $4000 twenty-payment whole life policy. When he was 25, he could pay no more premiums, and drew out the cash value of his policy. How much money did he receive?

2. Lyle Harwood bought a $5000 twenty-payment whole life policy when he was 20 years old. When he was 25, he used the cash value of the policy to buy paid-up insurance. What was the face of his new policy?

3. Katherine Shreve bought a $6000 twenty-payment whole life insurance policy when she was 20. When she was 25, she stopped working and married; so she decided to use the cash value of her policy to buy extended term insurance. For how many years could she continue to be insured for $6000?

4. At the age of 40, Mr. Harris purchased a $10,000 twenty-payment whole life policy. At the age of 45, he found himself unable to continue paying the premiums.

a. If he decided to draw out the cash value of his policy, how much money would he receive?

b. If he chose to use the cash value to buy paid-up insurance, how large a policy would he receive?

5. When Mr. Lee was 35, he bought a $3000 twenty-payment whole life policy. When he was 40, he decided to use the cash value to buy extended term insurance.

a. For how many years will his term insurance be in force?

b. How old will Mr. Lee be when his term insurance expires?

Temporary Protection

Some life insurance policies provide protection for as short a term as five or ten years. These temporary policies are called *term* life insurance policies.

Suppose a man buys a five-year term policy. His life is insured for the face of the policy for five years. At the end of that time, the policy no longer protects him. If he wants to be insured, he will either have to renew his term insurance (paying a higher premium, for he is five years older) or change it to straight whole life insurance.

A term policy has no cash value. If a policy-holder cannot continue to pay his premiums, he loses the money he has already paid. However, the premiums are small. For instance, one company charges a man of 20 an annual premium of $6.11 per $1000 for five-year term insurance.

The low premium is one reason why some people buy term insurance. If a person's income is so small and his expenses so large that he cannot afford to pay the premiums on whole life insurance, he may take out term insurance, with the intention of changing it to whole life insurance as soon as he can afford to do so.

Term insurance is also useful when a person borrows money. For example, a man who has a mortgage on his house may buy a term policy for the amount of his mortgage. If he should die before the mortgage is paid off, his term insurance policy will pay his debt, and his family need not have that burden.

Still another reason for buying term insurance is to give extra protection when it is most needed. A man may buy term insurance to cover the years while his children are growing up. Usually such a person has straight whole life insurance as well.

PROBLEMS

1. Mr. Orma, who is 30 years old and has a family, has just started a business of his own. For the present he wishes to be insured at the lowest rate. He decides to purchase a $10,000 five-year term policy for which he must pay an annual premium of $8.74 per $1000.

a. What will the policy cost him each year?

b. What will the policy cost him in all?

c. How much will his beneficiary receive if he dies at the age of 33?

d. What will his beneficiary receive if he dies at the age of 38?

2. Mr. Dale bought a ten-year term insurance policy at the age of 30. The face value of the policy was $3000. The annual premium was $9.04 per $1000.

a. What did the policy cost him each year?

b. What was the total cost of the policy?

c. If Mr. Dale should die at the age of 35, what amount would his beneficiary receive?

d. If Mr. Dale should die at the age of 41, what amount would his beneficiary receive from the policy?

3. Mr. Baxter bought a twenty-year term life insurance policy for $5000 when he was 30 years old. The annual premium was $10.04 per $1000. Mr. Baxter died when he was 44. How much more did his beneficiary receive than the total amount Mr. Baxter had paid?

4. Mr. Marsh, who is 35 years old, owes $8000 on his house. He expects to be able to pay this debt within ten years. Because he does not want his wife to be burdened with this debt if he should die, he decides to buy an $8000 ten-year term life insurance policy, for which he must pay an annual premium of $9.77 per $1000. What will be the total cost of the policy?

5. A certain company charges an annual premium of $8.17 per $1000 on a ten-year term policy when purchased by a man aged 20, and $9.04 per $1000 when purchased by a man aged 30. What is the difference in the total cost of a $6000 ten-year policy when bought by a man aged 20 and when bought at the age of 30?

Dividends

You may have heard about life insurance dividends. The money that policy-holders pay in premiums does not lie idle. It is invested and earns interest. On policies known as *participating* policies, extra profits are distributed as dividends to the policyholders.

Some holders of participating policies draw out their dividends as cash. Others apply them to reduce their premiums. Still others leave them with the company to draw interest or use them to buy more life insurance.

Policies on which dividends are not paid are called *non-participating* policies. Premiums are usually slightly lower on non-participating policies than on participating policies.

PROBLEMS

1. At the age of 25, Harold Williams bought a non-participating ordinary whole life policy for which he paid a premium of $16.56 per $1000. At the same age, George Robbins bought a participating ordinary whole life policy for which he paid a premium of $21.90 per $1000. When Mr. Robbins began to receive dividends, he applied them to the premium. On the average, his dividends were $5.87 per $1000.

a. What was the annual net cost per $1000 of Mr. Robbins' policy?

b. Of the two policies described, which cost less per year?

2. Mildred Simpson wanted $6000 worth of insurance and was trying to decide whether to buy a participating or a non-participating twenty-payment whole life insurance policy. The agent told her that her annual premium would be $33.88 per $1000 on a participating policy and $28.26 on a non-participating policy. He also said that the previous year the dividend on participating policies had been $4.73.

a. If Miss Simpson should buy a non-participating policy, what annual premium would she pay?

b. If Miss Simpson should buy a participating policy and apply the dividends to the premium, what might she expect the annual net cost to be?

3. During a period of ten years, a company paid an average annual dividend on participating term insurance policies of \$3.47 per \$1000. Mr. Raymond held a \$7000 participating ten-year term insurance policy issued by this company, for which he paid an annual premium of \$13.37 per \$1000. How much did Mr. Raymond's life insurance protection for ten years actually cost him?

4. Mr. Dorsey had a \$5000 participating whole life policy, paying an annual premium of \$22.10 per \$1000. He allowed the dividends to remain with the company and to draw interest. Fifteen years after buying the policy, Mr. Dorsey died. His beneficiary received \$5401.25 from the company.

a. How much did his beneficiary receive in dividends and interest for each \$1000 of the face of the policy?

b. How much did Mr. Dorsey pay for his policy in all?

5. Mr. Holmes purchased a \$5000 participating twenty-year endowment policy, paying an annual premium of \$48.85 per \$1000. He did not withdraw his dividends, but he left them with the company to earn interest. When his policy matured, the dividends plus interest totaled \$115.80 per \$1000.

a. How much did Mr. Holmes pay in premiums during the years?

b. How much did he receive from the company (including dividends and interest) when his policy matured?

c. How much more did he receive than he paid?

Insurance to Provide Regular Income

So far, nothing has been said about the form in which the beneficiary receives the face of a life insurance policy. The decision on this matter is one which the policy-holder may make. The holder of a whole life policy may want his beneficiary to receive the face of the policy in one lump sum. Often, however, he decides to have the insurance company pay a stated amount each month as long as the beneficiary lives. Sometimes he chooses a combination of the two methods — a lump sum to provide for unusual expenses at his death, followed by an income during the life of his beneficiary.

Similarly, the holder of an endowment policy may decide whether he wants to receive the face of his policy at one time or in smaller amounts at regular intervals. Since most people like to feel sure of a regular income, more and more policyholders are deciding to have the money due from the insurance company paid in installments. Others are providing for a regular income by buying policies called *annuities*.

A life annuity provides for the payment of money by an insurance company in equal installments from a specified date for the rest of the purchaser's life. A life annuity can be purchased for a single individual, or for a husband and wife (to continue so long as either shall live).

When a person wants annuity payments to begin at once, he pays the insurance company a single sum of money, and receives a contract called an *immediate* annuity. When he wants the payments to begin at some future date, he pays the premium in regular installments over a period of years, and receives a contract called a *deferred* annuity. Immediate annuities are usually bought by elderly people with the savings of many years; deferred annuities are bought by young people in order to provide for the years far ahead.

The premiums paid to an insurance company are invested by the company in many ways. The income from these investments is used to pay the people who buy the annuities. If a purchaser should live longer than most people do, he receives more money than he has paid. Of course, if a purchaser dies sooner than most people do, he gets back less than his premium. If he bought a *straight* life annuity, the company keeps the balance; if he bought a *refund* life annuity, the company pays the balance to someone he named at the time of purchase. Sometimes the balance is paid in cash (cash refund annuity); sometimes the annuity payments are continued until the balance is paid (installment refund annuity). Naturally, either kind of refund annuity has a higher premium than a straight life annuity. People who want to get the largest possible income from their premiums buy straight life annuities; persons who want their premiums to provide for others

as well as themselves buy refund annuities. Table 16 shows the difference in the premiums for immediate annuities of the three kinds: straight life, cash refund, and installment refund.

Table 16. PREMIUM COSTS OF IMMEDIATE ANNUITIES PER $10 MONTHLY ANNUITY FOR MEN AGED 55–65 AND FOR WOMEN AGED 60–70, FOR STRAIGHT LIFE, INSTALLMENT REFUND, AND CASH REFUND ANNUITIES

Age Last Birthday		*Premium per $10 Monthly Immediate Annuity*		
Men	*Women*	*Straight life*	*Installment refund*	*Cash refund*
55	60	$2165.52	$2586.72	$2678.16
60	65	1873.42	2343.48	2450.04
65	70	1590.72	2103.60	2227.20

Table 16 shows that a man of 60 can receive $10 a month from his insurance company for the rest of his life by paying $1873.42. If he wants to receive $100 a month for the rest of his life, he must pay a premium of $18,734.20. A woman of 60 must pay $2165.52 for an immediate annuity of $10 a month, or $21,655.20 for an immediate annuity of $100 a month. Annuity premiums are more expensive for women than they are for men, because, on the average, women live longer than men, and receive annuity payments for a longer time than men of the same age.

PROBLEMS

1. Miss Brown, who is 65, wishes to buy an immediate straight life annuity of $50 per month. What premium must she pay the insurance company?

2. Mr. Weber, aged 55, bought an installment refund annuity of $50 per month. He died at 75 after receiving installments for exactly 20 years.

a. How much did Mr. Weber pay for his annuity?
b. How much did he receive in monthly installments?

c. What amount remained to be paid by the company?

3. When Miss Harris was 28 years old, she purchased a deferred life annuity to begin at the age of 60. For each $100 per year that she paid, the insurance company agreed to pay her an annuity of $37.23 per month. She paid a premium of $75 per quarter (four times a year).

a. How much had she paid in premiums when she reached the age of 60?

b. What annuity did she then receive each month?

c. Miss Harris lived to be 75 years of age. How much had she received from the company when she died?

LAMBERT

Because he bought a deferred annuity when he was young, this man was able to retire from business in his sixties.

d. How much more did she receive than she paid in premiums?

4. John Williams paid an insurance company a premium of $30 per month from his fortieth to his sixtieth birthday. Then the insurance company began paying him a monthly annuity of $21.20 for each $10 of the monthly premium.

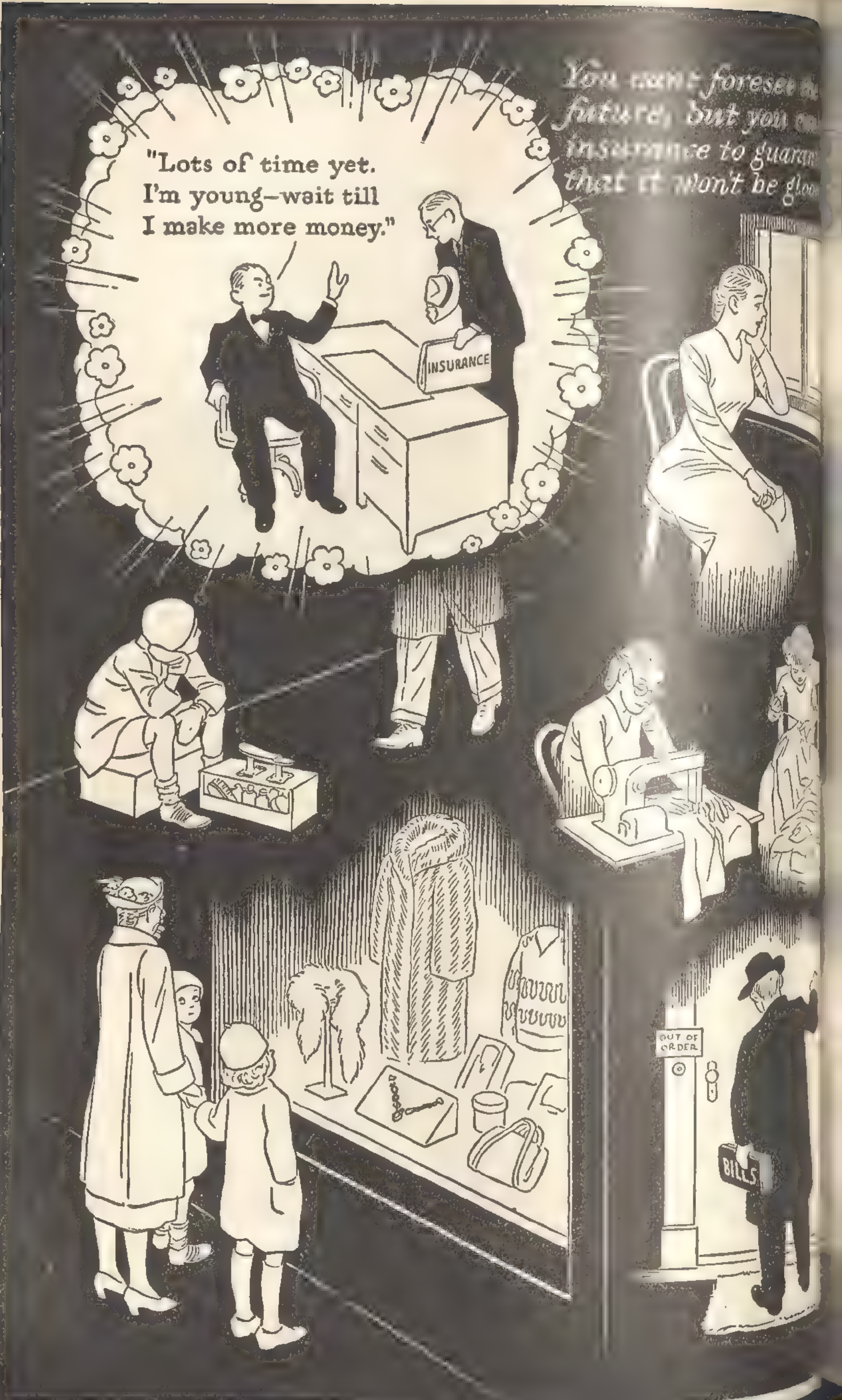
a. How much did he pay in premiums?

b. Mr. Williams died at 68. How much had he received from the company?

5. When Mr. Jamison was 45 years old he made a single payment of $5000 as a premium on an annuity to begin at the age of 60. He paid no further premiums. When he was 60 years old, the insurance company began to pay him a monthly annuity of $1 for each $100 of the premium.

a. What monthly income did he receive at the age of 60?

b. In how many months will he have received an amount equal to his total premium?



You can't foresee
future, but you
insurance to
that it won't be
"Lots of time yet. I'm young–wait till I make more money."
INSURANCE
OUT OF ORDER
BILLS

Insurance in Accident and Illness

Many persons want some form of financial protection in case of illness or accident. Some of them obtain this protection through special provisions in their life-insurance policies. Others buy health and accident insurance policies, or join group plans for insurance against medical and surgical expenses.

Special Provisions in Life Insurance Policies

A common provision in life insurance policies is called the *disability waiver.* If a policy-holder is disabled, the company will pay his premiums until he has recovered. If he is totally disabled, he need pay no more premiums.

A less common provision is *the disability income provision.* If this provision is included, the premiums are considerably higher than usual, but the policy-holder is assured of a monthly income if he should become disabled.

Many life insurance policies contain a *double indemnity clause.* This clause provides that, if the policy-holder dies as the result of an accident, his beneficiary receives double the face of the policy.

Table 17 shows how much one company charges to include disability waiver and double indemnity clauses in whole life policies purchased at the age of 25.

Table 17. ANNUAL PREMIUM PER $1000 AND ADDITIONAL COST OF DISABILITY WAIVER AND DOUBLE INDEMNITY CLAUSES: STRAIGHT WHOLE LIFE AND TWENTY-PAYMENT WHOLE LIFE PURCHASED AT AGE 25

Kind of Policy	*Annual Premium*	*Disability Waiver*	*Double Indemnity*
Straight life	$20.14 per $1000	$.79 per $1000	$1.25 per $1000
Twenty-payment	$30.12 per $1000	$.56 per $1000	$1.50 per $1000

PROBLEMS

In solving these problems, refer to Table 17 as necessary.

1. Mr. Cook, aged 25, purchased a $5000 straight whole life policy having both disability and double indemnity clauses. What annual premium did he pay?

2. Mr. Darrell, aged 25, purchased a $5000 twenty-payment whole life policy having both disability and double indemnity clauses. What annual premium did he pay?

3. When Mr. Sandburg was 25, he purchased a $7000 twenty-payment whole life policy having both disability and double indemnity clauses. He is now 45. How much more has he paid in premiums than he would have paid if his policy had not included these clauses?

4. When he was 25, Mr. Weaver bought a $5000 straight whole life policy with a disability clause. At the age of 50, Mr. Weaver was in an accident which blinded him. He lived until he was 67.

a. How much had Mr. Weaver paid the company at the time of his accident? (26 premiums)

b. How much would he have paid by the time of the accident if he had not had the disability clause?

c. How much did he pay the company after the accident?

d. How much did his beneficiary receive at his death?

5. At the age of 25, Mr. Huntington bought a $4000 twenty-payment life insurance policy with a disability clause. Mr. Huntington was totally disabled when he was 46 years old. He died eight years later.

a. How much money had Mr. Huntington paid in premiums at the time of his accident?

b. How much money did his beneficiary receive?

Health and Accident Policies

The cost of health and accident insurance policies varies according to their provisions. Some provide for the payment of a regular income during illness; some provide for the payment of doctor's bills and hospital expenses.

PROBLEMS

LAMBERT

This man's health insurance policy provides for a regular income while he is ill.

1. For eight years, Mr. Morrell has had an accident insurance policy for which he pays an annual premium of $31.70. His policy provides for payment by the insurance company of the following:

- $100 per month for all loss of business time
- $1000 for loss of life in an accident; $2000 for loss of life in an accident occurring while traveling
- $1000 for the loss of two members of his body such as eyes, legs, or arms; or $2,000 if the accident occurs while traveling
- Up to $500 for medical and hospital services
- Up to $100 for transportation if the accident occurs away from home

Recently Mr. Morrell was injured in a train wreck. He recovered completely, but was unable to work for three months. His expenses were as follows: doctor, $115; hospital expenses, $250; nurse, $125; transportation to his home town, $25.

a. How much did he receive from the insurance company?

b. How much more did he receive than he had paid in premiums?

2. Mr. Stocking has been paying an annual premium of $32.50 for nine years on a health insurance policy with the following provisions:

- $25 per week for the loss of business time beginning after 2 weeks and continuing up to 52 weeks
- $12.50 per week additional for time spent in a hospital up to 20 weeks
- $100 for expenses of an operation

Recently Mr. Stocking had a severe illness requiring an operation. The operating expenses were $150. He was in the hospital 8 weeks and away from work 13 weeks.

a. What amount did he receive from the insurance company?

b. How much more did he receive than he had paid in premiums?

3. Miss Holman earns $60 a week and pays $66.40 a year for a health and accident policy which includes the following benefits:

$25 a week for loss of business time, beginning after two weeks and continuing up to 50 weeks

$12.50 a week additional for time in the hospital, up to 13 weeks

Miss Holman had had her policy for 8 years, when she first needed its benefits. Her illness lasted for 30 weeks, 10 of which she spent in a hospital. Her salary stopped after she had been ill for four weeks.

a. How much did Miss Holman receive from her insurance company?

b. How much more did she receive than she had paid in premiums?

c. How much less was her total income than it would have been had she not become ill?

4. Miss Gray has group hospitalization insurance for which she pays $2.70 a month. She is entitled to $12.00 a day for hospital care for 120 days. However, she must pay her own doctor's bill. One year she was in the hospital for 50 days, and received a hospital bill of $16.50 a day.

a. What was the cost of Miss Gray's hospitalization insurance per year?

b. How much was the hospital bill?

c. How much of the bill did Miss Gray have to pay?

5. Mr. Masone pays $5.40 per month for a family membership in a group hospitalization plan. If he or his wife or any of his children under 19 require hospital service, he will receive up to $12.00 a day for 120 days. One year his wife was in

the hospital for 10 days, for which he was charged \$175, and his son was hospitalized for three days at \$15 a day. How much did their hospitalization cost Mr. Masone including his hospitalization premiums for the year?

Social Security

To some extent, the Federal government provides insurance for workers and their dependents. Under the Social Security Act, everyone in certain occupations has a small percentage of his wages withheld by his employer every payday. This money, plus an equal amount paid by the employer, goes into his account with the Social Security Administration. When the worker retires (if he is 65 years old or older), he receives a monthly income based on his average monthly wage (up to \$300) in jobs covered by Social Security. If he has dependents (for example, a wife 65 years old or older, or young children), he will receive additional money each month. When he dies, his dependents receive monthly payments which are a proportion of his monthly retirement income.

Another kind of social security is supplied by unemployment insurance. The Social Security Act gives the Federal government power to work with the separate states in providing unemployment insurance for workers who lose their jobs (not for those who quit voluntarily).

Old Age and Survivors' Insurance

Every worker who retires under the Social Security Act, with its amendments including that of 1952, receives a monthly income called the *primary insurance amount*, or *primary benefit*. The amount of this monthly income for workers claiming benefits based on earnings after 1950 is computed on the basis of the average amount the worker earns, up to \$3600 a year, in a covered occupation.

The additional amount paid dependents varies with the number of dependents and the size of the primary benefit.

The exact amount of monthly income that a worker will receive when he retires cannot be known until the date of retirement. However, an approximate amount can be computed if the worker's average earnings are known. To figure the monthly income, take 55 per cent of the first \$100 of average monthly earnings and add 15 per cent of the balance up to \$200 a month. For example, if the average monthly earnings equal \$280, take 55 per cent of \$100 and 15 per cent of the remaining \$180.

$$\begin{aligned} 55\% \text{ of } \$100 &= \$55.00 \\ 15\% \text{ of } \$180 &= 27.00 \\ \text{Total} &= \$82.00 \end{aligned}$$

To pay the cost of Social Security, the worker and his employer are both required to pay Social Security taxes. The rate for each for the years 1954 to 1959 is 2 per cent of the worker's wages up to \$3600 a year. This rate is scheduled for an increase to $2\frac{1}{2}$ per cent after 1959.

PROBLEMS

As the earnings of most of the students studying this book will fall under the provisions of the Social Security Act as amended in 1952, the problems that follow are based on this amendment.

1. Martha Hansen, who works on a job covered by Social Security, has an income of \$3000 a year.

a. What is Martha's average monthly income?

b. How much Social Security tax is deducted from her pay each month?

c. How much additional does her employer pay into her Social Security account per year?

2. Richard Gardner earns \$4000 a year on a job covered by Social Security.

a. On how much of his annual income must Richard pay a Social Security tax?

b. How much Social Security tax must he pay per month?

c. How much additional does his employer pay into his Social Security account per year?

3. Assuming that Sarah Colwell earns $3200 a year for 3 years and $3400 a year for 5 years:

a. Find her total earnings for the 8 years.
b. Find her average annual earnings.
c. Find her average monthly wage.

4. James Brown earned $3000 a year for 3 years and $3500 a year for the next 7 years.

a. What was his total income for the ten years?
b. What was his average annual income?
c. What was his average monthly wage?

5. Mrs. Clement has a part-time job covered by Social Security in which she earns $80 a month. She is planning to retire in 10 years, at which time she will be 65 years old. As she has no dependents, she will be entitled to the primary benefit only. Assuming that she continues to earn $80 a month until retirement, what will be the amount of her monthly benefit? (55 per cent of $80)

6. Mr. Miller earns $240 a month on a job covered by Social Security. He is planning to retire at age 65 in 1970. As he has no dependents, he will be entitled to only the primary benefit. Assuming that he continues to earn $240 a month until he retires, what will be the amount of his monthly income? (55 per cent of the first $100 and 15 per cent of $140).

7. Mr. Borchert, who earns $300 a month, is planning to retire in 20 years under the Social Security Act. His wife, who will be 65 when he retires, is dependent on him, so the payments will be increased by an amount equal to $\frac{1}{2}$ the primary benefit. Assuming that Mr. Borchert's earnings continue at the present rate, what monthly income will Mr. and Mrs. Borchert receive?

Unemployment Insurance

When a worker in an occupation covered by the Social Security Act loses his job, he may apply for unemployment insurance benefits. While the benefits are being paid, the State Employment Office helps the worker find a new job.

The money to pay unemployment insurance benefits comes from employers. In most states, employers contribute to the state unemployment insurance fund an amount equal to 2.7 per cent of each worker's pay up to $3000 a year. They also contribute .3 per cent of the same amount to the Federal government, for use in administering the fund and in maintaining the employment office.

PROBLEMS

1. Warren Monroe earns $3750 a year on a job covered by unemployment insurance.

a. How much does his employer pay to the state government for his unemployment insurance each year? (2.7 per cent of $3000)

b. How much does his employer pay annually to the Federal government for Warren's unemployment insurance? (.3 per cent of $3,000)

2. Robert Allen earns $360 a month in an occupation covered by unemployment insurance.

a. How much does Robert earn per year?

b. How much does his employer pay to the state government for his unemployment insurance per year?

c. How much does the employer pay to the Federal government for his unemployment insurance for a year?

3. In a recent year the total payments to unemployed in the United States amounted to $912,898,000. This represented compensation for 40,850,000 weeks of unemployment. The average beneficiary drew benefits for 10.2 weeks.

a. Find the average rate of compensation per week.

b. Find the average total benefit per worker.

4. One year the state of Texas paid weekly unemployment insurance benefits to 59,000 individuals. The total amount of the payments was $9,290,000. What was the average amount each worker received?

Every worker in occupations under Social Security has a card like this. The number identifies his account with the Social Security Administration.

GENDREAU

ACK STAR

A tornado can wreck a house. In parts of our country where tornadoes occur often, many people buy tornado insurance.

Insurance and Your Possessions

After you have saved your money and made some major purchase, you want to protect yourself against the loss of your property. Insurance companies will insure your possessions against fire, theft, and damage of almost every conceivable kind. So car owners buy insurance on their automobiles; home owners insure their houses and furniture; farmers take out insurance against crop failures; storekeepers insure their plate-glass windows; collectors insure their collections of stamps, minerals, pictures, or other objects; travelers buy insurance on their luggage; and so on.

Automobile Insurance

A person buys automobile insurance for the same reason that he buys other kinds of insurance — to provide protection. The hazards of owning and operating an automobile are well known. They are listed on the next page.

BLACK STAR

This accident occurre[d] because of excessi[ve] speed on a slipper[y] road. Collision with telephone pole result[ed] in damage to the car.

(1) An automobile may cause injury to another person, or even death.

(2) An automobile may damage another person's property; for example, the driver may back into another car and crumple its fender.

(3) An automobile may be stolen or catch on fire, or it may be damaged in a wind storm.

(4) An automobile may be damaged by collision with another object; for example, the driver may run it into a fire hydrant, a telephone pole, or another car.

Many car owners insure themselves against all these hazards; every sensible car owner insures himself against the first — causing injury to another person. No matter how skillful a driver is, there may come a time when he cannot avoid an accident in which someone is injured or even killed. When a tragedy such as this happens, a car owner wants to know that at least there is enough money to pay all the damages for which he may be judged liable. If he is unable to pay, some innocent person may suffer great hardship.

Public liability insurance protects you against your liability for bodily injuries, illness, and death suffered by any person as a result of an accident caused by your car. (It is also called *bodily injury liability* insurance.) It is the most important

kind of automobile insurance you can buy. It may be expensive. In some places it is higher for young people than for those over 25, for young people have more accidents. But if a person cannot afford to buy public liability insurance on his car, he should not consider himself able to own it.

Public liability insurance does not protect you against your liability for damage to another person's property. For this purpose, you need *property damage liability* insurance. Together, these two forms of insurance protect you in case your car harms other persons or their property.

To protect you against loss of your car by theft, you may buy theft insurance; and to protect you against loss by fire, you may buy fire insurance. Or you may buy what is called *comprehensive* insurance. Comprehensive insurance protects you against damage and loss by theft, fire, hurricane, flood, vandalism, and the like. It does not protect you against loss by upset or by collision with an object such as a tree. It does not protect you against loss from damage to your own car if you run into another automobile. For such protection you must buy *collision* insurance.

The four kinds of automobile insurance that many careful car owners buy are as follows:

(1) public liability
(2) property damage liability
(3) comprehensive
(4) collision and upset

Do you see that these match the four kinds of hazards of automobile ownership?

Rates for automobile insurance vary with the make and age of the car and with the community in which it is kept. Rates for cars kept in cities are higher than for those used mostly in rural areas. Rates are higher if the insurance company agrees to pay small claims (under $50) than if the company pays only claims over $50. This kind of insurance is known as *deductible insurance*. If you carry $50 deductible collision insurance, and damage your car to the extent of $75, you receive only $25.

Some insurance companies give rebates for safe driving; some make reductions in their rates for drivers who have excellent safety records; some pay dividends on the money car owners have invested in insurance.

PROBLEMS

1. Mr. Young has public liability insurance and property damage liability insurance in a company that allows a 12 per cent rebate if no claims are made during the year. Last year his insurance cost him $49.38, but he had no accident claims of any sort. How much was returned to him at the end of the year?

2. Miss Woodring carries $50 deductible collision and upset insurance on her car, as well as other forms of insurance. One icy night her car skidded into a ditch and was damaged to the extent of $145. How much of this amount did the insurance company pay?

3. Miss Taylor has just bought a new car for which she paid $1950. She bought public liability insurance to the extent of $25,000 for each person injured or killed and $50,000 for each accident, paying a premium of $27.94. She bought property damage liability insurance for $5000 for each accident, for which the premium was $13.50. She also bought comprehensive insurance for the actual cash value of the car, paying a $9.00 premium.

a. How much did Miss Taylor pay for her insurance?

b. If her car should be stolen and not recovered, how much would the insurance company pay her?

c. If she should damage another car while backing into a parking space, would the insurance company pay the claim?

d. If she should damage her own car while putting it into her garage, would the insurance company pay the claim?

4. Mr. Seafield carried public liability insurance to the extent of $10,000 for each person and $25,000 for each accident. He also had $5000 property damage liability insurance and $1000 comprehensive insurance. Recently he was involved in an accident in which his car was completely wrecked and another car damaged to the extent of $235. Mr. Seafield was

judged liable for the hospital bills for the driver of the other car. These bills amounted to $600. How much did the insurance company have to pay on account of Mr. Seafield's claims?

5. Mr. Clark carried public liability insurance to the extent of $5000 for each person and $10,000 for each accident, and property damage liability insurance for $5000. He has no other insurance on his car. In an automobile accident, his car injured two persons and damaged the car in which they were riding. The damage to their car amounted to $400. The damage to Mr. Clark's car came to $250. One of the injured persons was awarded $3000 in damages, and the other was awarded $2250.

a. Was Mr. Clark fully protected against these losses?
b. How much did the accident cost the insurance company?

Fire Insurance

One of the most common types of property insurance is fire insurance. Almost everyone who owns a house wants to insure it against fire. Persons who rent their homes want to insure their furniture against fire. The cost of fire insurance on a house or its contents is small in comparison with the value of the property.

The premiums charged for fire insurance on a house depend on factors such as the following:

(1) Type of construction: A lower rate is charged for a brick house than for a frame house. The rate is lower for a house with a fireproof roof than for one with a roof that is not fireproof.

(2) Location of the house: The rate for fire insurance on a house located in a city with a good fire department is less than the rate on a house in a small town where fire protection is inadequate or on one in the country far from a fire department.

(3) Number of dwelling units: The rate for a one-family house is less than the rate for a similar two-family house. The rate for a two- or three-family house is less than the rate for a large apartment house of similar construction.

GENDREAU

When you consider ho[w] completely fire can d[e]stroy a home, fire insu[r]ance premiums seem [a] small price to pay f[or] protection.

(4) Term of the insurance: The rate charged for three years is less per year than the rate charged for one year.

(5) Occupancy: The rate on an occupied house is less than the rate on a similar vacant house.

The cost of fire insurance on the contents of a house is affected by the same factors. Sometimes fire insurance on furniture is charged at the same rate as fire insurance on the house itself; sometimes the rate is a little higher.

Some persons carry what is known as "extended coverage" on their house and furniture. This insurance, which protects the owner against loss due to fire or lightning, also includes protection against direct loss by windstorm, hail, explosion, riot, riot attending a strike, civil commotion, aircraft, vehicles, and smoke.

PROBLEMS

1. Mr. Adams and Mr. Barclay live next door to each other in a small city. Mr. Adams' house is of brick construction and has a slate roof. His annual premium for fire insurance is \$.12 per \$100. Mr. Barclay's house is of frame construction and has a wood shingle roof. His fire insurance premium is \$.22 per \$100 each year. Each house is insured against fire for \$9500.

a. What does Mr. Adams pay for his fire insurance?

b. What does Mr. Barclay pay for his fire insurance?

2. The Canbys' house is located in a rural area. It is of frame construction, with a roof of asbestos shingles. The Canbys carry a \$7800 fire insurance policy, for which the annual premium is \$.32 per \$100. The Denfields own a similar house which they insure for the same amount. Since their house is located in a town with a good fire department, they pay only \$.14 per \$100 for their fire insurance each year.

a. How much do the Canbys pay for their fire insurance?

b. How much do the Denfields pay for their fire insurance?

3. The Elders live in a frame house with a wood shingle roof. It is located in a small town. The annual fire insurance premium rate is \$.36 per \$100, but the Elders renew their fire insurance every three years, paying $2\frac{1}{2}$ times the annual rate. Their policy is for \$6800. The Fosters live in the same town. Their house, too, is of frame construction, but it has a fireproof roof; so the annual fire insurance premium rate is \$.30 per \$100. The Fosters carry a \$6800 fire insurance policy, which they take out for a three-year term at $2\frac{1}{2}$ times the annual rate.

a. How much does the Elders' fire insurance cost them every three years?

b. How much does the Fosters' fire insurance cost them for three years?

4. The Goldens live in a brick house with an asbestos roof, located in a small city. The annual extended coverage insurance rate on the house is \$.16 per \$100; the rate on its furniture is \$.22 per \$100. The Goldens insure their house for \$10,500, and their furniture for \$3200. What do they pay for their extended coverage insurance each year?

5. Mr. Hawkins owns a two-family brick house with an approved roof and a three-family house of the same construction. The fire insurance on the two-family house costs \$.12 per \$100 per year; the fire insurance on the three-family house costs \$.16 per \$100 per year. Each house is insured for \$12,500. Find the difference in the annual fire insurance premiums on the two houses.

What You Have Learned in This Chapter

1. How the cost of life insurance differs at different ages
2. What kinds of life insurance policies afford lifetime protection: straight whole life, life paid-up at age 65, limited-payment whole life
3. What endowment policies are
4. How the cost of life insurance varies with the kind of policy
5. What the holder of a life insurance policy can do if he can no longer pay his premiums
6. What is meant by term insurance
7. How life insurance policies may provide a regular income
8. How health and accident insurance can provide protection
9. The extent to which the Federal government helps provide security through the Social Security Act
10. What automobile insurance a car owner should buy
11. That fire insurance on a house costs little in comparison with the value of the property insured
12. To use these terms in discussing insurance: *policy, policyholder, beneficiary, face of a policy, premium, annuity*

What kinds of insurance would you recommend for young people such as these?

Review Test on Insurance

1. When he was 17, Tom Mehaffey bought a straight whole life insurance policy with a face value of $3000, paying an annual premium of $14.98 per $1000. Last year, at the age of 34, Mr. Mehaffey died. He had made 17 premium payments.

a. What premium did Mr. Mehaffey pay each year?
b. How much did he pay in premiums all together?
c. How much did his beneficiary receive at his death?

2. The annual premium on a certain twenty-year endowment policy purchased at the age of 25 is $46.11 per $1000. Mr. Henshaw bought a $4000 policy of this sort when he was 25, and paid the premiums until the policy matured.

a. What was the total cost of the policy?
b. How much did the insurance company pay Mr. Henshaw when he was 45?

3. Grace Montgomery has a $4000 participating straight whole life insurance policy, for which she pays an annual premium of $28.16 per $1000. The annual dividends on this policy average $5.48 per $1000. How much does the policy actually cost Mrs. Montgomery each year?

4. A certain health and accident insurance policy has an annual premium of $60. It includes the following provisions:

$100 per month for loss of business time (no time limit)
$200 per month for loss of business time as a result of travel accident (no time limit)
$150 additional per month for time in the hospital, up to three months
$25 for doctor's fees on non-disabling injuries
$5000 if death results from an accident
$2500 additional for loss of two members (eyes, feet, or hands)

Refer to the provisions of the above policy and answer the following questions:

a. How much will the insured receive if he is ill at home (absent from work) three months because of illness?
b. How much will the insured receive if he is in a hospital

three months and absent from work a total of five months as a result of a train wreck?

c. How much would the insured receive if he became blind as a result of an accident?

d. How much would the beneficiary receive if the insured were killed in an accident?

5. Mr. Alfreds, who is 63 years old, finds that he must pay a premium of $1657.70 per $10 monthly immediate straight life annuity. He is able to buy an annuity of $150 per month.

a. How much does he pay for his annuity?

b. If he lives to be 80, how much money will he receive in annuity payments?

6. Mr. Isaacs retired at the age of 65. His average pay for the years he worked in an occupation covered by Social Security was $250 per month. He has one dependent, his wife, who is the same age as he is. His primary benefit is equal to 55% of the first $100 of his monthly pay and 15% of the remainder. His wife's benefit is equal to $\frac{1}{2}$ his primary benefit.

a. Find Mr. Isaacs' primary benefit.

b. Find his wife's benefit.

c. What total monthly income do Mr. and Mrs. Isaacs have from Social Security?

d. How would your answers to **b** and **c** differ if Mrs. Isaacs were less than 65 years old?

7. In a certain year, the state of Nebraska paid weekly unemployment insurance benefits to 9953 individuals. The total amount paid that year was $1,568,000. The total number of payments was 104,000.

a. What was the average weekly benefit?

b. What was the average number of payments to a single worker?

8. Richard Owings has a new car for which he paid $2100. He bought public liability insurance costing $23.40 and property damage liability insurance costing $9.00. He also purchased comprehensive insurance for the actual cash value of the car, paying $1.35 per $100. How much did Mr. Owings' automobile insurance cost him?

9. Mr. Jamison carries public liability insurance on his automobile to the extent of $5000 per person and $10,000 per accident. He also has $5000 property damage liability insurance. He has no other insurance. Recently Mr. Jamison was involved in an accident for which he was judged liable. His car injured three persons and damaged the car in which they were riding. Each of the injured persons was awarded $2500 for bodily injury, and the owner of the car was awarded $800 for the damage done to it. Mr. Jamison's own automobile was damaged to the extent of $230.

a. How much money did the insurance company have to pay because of Mr. Jamison's accident?

b. How much money did Mr. Jamison himself have to pay?

10. The Johnsons carry fire insurance on their house for $8500 and on its furnishings for $3500. The rate per year is $.32 per $100 on the house and $.38 per $100 on the furnishings.

a. What annual fire insurance premium do the Johnsons pay?

b. If the rate for a three-year policy is $2\frac{1}{2}$ times the rate for a one-year policy, how much could the Johnsons save in three years by buying their fire insurance for a three-year term instead of for three one-year terms?

How do you rate?	Excellent	Good	Fair	Poor
	9–10	8	6–7	5 or less

CHAPTE 10

GALLOWAY

1. Find out just how a person would go about asking for a loan at a local bank. What rate of interest does the bank charge?
2. From an officer or member of a credit union, find out what rate of interest is charged and how much money a member may borrow.
3. Study the advertisements of a small-loan company and calculate the true rate of interest on the loans it offers.
4. If you can, look at the articles displayed in a pawnbroker's window to see the kinds of security on which a pawnbroker lends money.

BORROWING MONEY

IT IS QUITE GENERALLY agreed that most persons should not borrow money if they can possibly avoid doing so. There are times, however, when borrowing is a wise thing to do. For example, a man may borrow money to buy a house: he and his family can live in it while paying for it.

Before you decide to borrow money, ask yourself three questions:

(1) Do I *really need* the money I am planning to borrow?
(2) Is the rate of interest on the loan reasonable?
(3) Is my income sure enough and large enough so that I can include payments on the loan in my budget without giving up necessities?

Only if you can answer "Yes" to all three questions should you make arrangements to borrow.

Banks and Insurance Companies

Institutions for saving money are also institutions for lending money. A bank, for example, has money to lend — the money its depositors put into their savings accounts. It is by lending this money at interest that the bank earns enough to pay interest on the savings account and to pay all the expenses of doing business. An insurance company similarly has money to lend — the money its policyholders pay as premiums.

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"My treat today, gang! Who's got a dollar to loan me?"

Security for Loans

Of course, the officials of institutions for savings have to be careful to lend money only to individuals who will pay it back when due. There are two general methods by which they assure themselves that their money will be returned:

(1) If the borrower has lived in the same community for some time, has a steady income and a reputation for promptness in paying bills, and is known to the officials of a bank as a person of honor, the bank may lend him money on his signature alone. Such a loan is called a *character loan*. The borrower signs a *promissory note*, which is a promise to pay back

the money with interest on a certain date. The signer of a promissory note is called its *maker*. Often a second person signs the note as a *co-maker*. A co-maker agrees to repay the loan, plus interest, if the borrower himself fails to do so.

(2) As *security* for his loan, the borrower may give the bank a *mortgage* on some of his property, or he may offer *collateral*, such as stocks and bonds. If he does not repay the loan when it is due, the bank has a legal right to the mortgaged property or the collateral. A life insurance policy with a cash value is good security for a loan. A borrower may assign his policy to a bank, or he may borrow up to the cash value from his life insurance company. If he should die before paying back the loan, the insurance company deducts what he owes (plus interest) before paying the face of the policy to the person he named as his beneficiary.

Banks will not lend you money unless their experts believe you will pay it back. Insurance loans are secured by the cash value of life insurance policies. Banks and insurance companies usually charge from 4 to 8 per cent per year. These rates are lower than those on installment purchases.

Interest on loans is figured just as is interest on installment purchases and on bank deposits: Multiply the principal by the rate per year times the time in years or fractions of years: $I = P \times r \times t$.

PROBLEMS

1. Steve Cronin, who had lived in Prairie Center all his life, borrowed $500 from the local bank to help with his expenses during his senior year at the college of agriculture. His co-maker was a man who owned property in Prairie Center. The interest rate was 6 per cent per year, payable when the loan was repaid. Steve repaid the loan after 1 year and 3 months. How much interest did he pay?

2. Mr. Owens gave his life insurance policy, which had a cash value of $650, as security for a bank loan of $500. At the end of 9 months he repaid the loan with interest at 5 per cent per year. How much interest did he pay?

WIDE WORLD

The "Citizens Bank" is run by and for the young people of the community. Here a boy receives the loan for which he has applied.

3. Mr. Johnson did not carry property damage insurance on his automobile. As a result, he had to borrow \$400 from a bank to pay for damages to the car of another person. He gave a life insurance policy with a cash value of \$648 as security. At the end of 8 months he repaid the loan with interest at $4\frac{1}{2}$ per cent. How much money did he pay the bank at that time?

4. James Northrop has a life insurance policy having a cash value of \$170. He is planning to borrow \$160 from the insurance company to be repaid in a lump sum at the end of 8 months. How much interest will he have to pay if the rate is 5 per cent per year?

5. On July 1 of last year, Robert Stahl borrowed \$750 from a life insurance company at 5 per cent interest, using the cash value of his \$10,000 life insurance policy as security. On New Year's Day, Mr. Stahl was killed in an accident. He had paid no interest on his loan, nor had he paid back any of the principal. How much did the insurance company pay his beneficiary?

Installment Payments

Suppose you borrow \$300 from a bank today, and promise to pay \$100 plus interest one month from today, another \$100 plus interest two months from today, and the third \$100 plus interest three months from today. You are paying interest on three different principals. When you make the first payment, you pay interest on \$300; when you make the second payment, you pay interest on \$200; when you make the third

payment, you pay interest on \$100. In each case, your interest equals the product of the principal, rate, and time: $I = P \times r \times t$.

Example

Mr. Grant wished to purchase a lot on which to build a home. He owned public utility bonds having a value of \$2000. He gave these bonds to the bank as security and was granted a loan of \$1500 at $4\frac{1}{2}$ per cent interest per year. He agreed to pay \$500 plus interest at the end of each year for three years. Find the total amount of interest on the loan.

What to Do	How to Do It
(1) Find the interest for the first year.	$P = \$1500$; $r = .045$; $t = 1$ $I = P \times r \times t$ $I = \$1500 \times .045 \times 1 = \$67.50$
(2) Find the principal for the second year. Use it to find the interest for the second year.	First payment = \$500 New principal = \$1500 − \$500 = \$1000 $I = \$1000 \times .045 \times 1 = \$45$
(3) Find the principal for the third year. Then find the interest for the third year.	Second payment = \$500 New principal = \$1000 − \$500 = \$500 $I = \$500 \times .045 \times 1 = \$22.50$
(4) Find the total amount of interest paid.	\$67.50 + \$45 + \$22.50 = \$135 Answer

PROBLEMS

1. William Saunders borrowed \$750 from a bank, assigning his life insurance policy as security. The rate of interest was 5 per cent per year on the balance due. At the end of 6 months, Mr. Saunders paid the interest due on his loan and \$250 on the principal. Six months later he again paid the interest plus \$250; and in another six months he repaid the loan in full. How much did the loan cost him?

2. Mr. Newman borrowed $2400 from a bank, giving a mortgage on a building he owned as security. The bank charged him 4 per cent interest. At the end of six months he paid the interest then due and $600 on the principal. He continued paying $600 plus interest due at the end of each six-month period until the loan was repaid. How much interest did he pay altogether?

3. Mr. Madison borrowed $1000 from his life insurance company, the cash value of his insurance policies being security for the loan. The rate of interest was $4\frac{1}{2}$ per cent. At the end of each year for 5 years, Mr. Madison paid the interest on the loan and $200 on the principal. How much interest did he pay on the loan?

4. Mr. and Mrs. Cary borrowed $2000 from a life insurance company to make a down payment on a farm. The company charged them $5\frac{1}{2}$ per cent interest. The loan was repaid at the rate of $400 a year. What was the total amount of interest paid?

5. Mr. Barker borrowed $1200 to make some improvements on his house. He gave the bank a mortgage on his house and lot as security. The bank charged him $4\frac{1}{2}$ per cent interest on the loan. Mr. Barker paid the interest due and $200 on the principal every 4 months. What was the total amount of interest paid?

When a Note Is Discounted

When the interest on a loan is deducted in advance, the borrower's note is said to be *discounted*. Most loans of this sort are for $300 or less, and are repaid in monthly installments.

Notes are usually discounted from 4 to 6 per cent. The real rate of interest is higher than the rate of discount, for the borrower does not have the use of all the money on which he pays interest for the entire period of the loan. The situation is similar to that of installment buying. (Chapter 5, pages 213-217.) To find the true rate of interest, follow this procedure:

(1) Find the amount of interest.
(2) Determine the average debt.

(3) Multiply the average debt by the length of time in years.
(4) Divide the amount of interest by the product, and express the quotient as a per cent.

Example

The Main Street Bank discounts personal loans at the rate of 6 per cent per year. Mr. Andrews borrowed \$100 from this bank, promising to repay it in four monthly installments of \$25 each. What rate of interest did he pay?

What to Do	How to Do It
(1) Find the amount of interest on the loan.	$p = \$100;\ r = .06;\ t = \frac{4}{12} = \frac{1}{3}$ $I = p \times r \times t$ $I = \$100 \times .06 \times \frac{1}{3} = \$2$
(2) Determine the average debt.	Debt the first month: $\$100 - \$2 = \$98$ Paid before last month: $3 \times \$25 = \$75$ Debt the last month: $\$98 - \$75 = \$23$ Sum of first and last debts: $\$98 + \$23 = \$121$ Average debt: $\$121 \div 2 = \$60.50$
(3) Multiply the average debt by the length of time in years.	$\frac{1}{3} \times \$60.50 = \$20.167$
(4) Divide the amount of interest by the product, and express the result as a per cent.	$\$2 \div \$20.167 = .0991$ $.0991 = 9.9\%$ Answer

PROBLEMS

1. Mr. Ward borrowed \$450 from the personal loan department of a bank. He agreed to repay the loan in 12 monthly payments of \$37.50 each. At the time the loan was made, the note was discounted at the rate of 6 per cent a year.

a. How much interest did Mr. Ward have to pay on the loan?

b. How much money did he receive from the bank?

c. What was the true rate of interest paid by Mr. Ward?

2. In order to take advantage of reduced prices at a furniture sale, Mr. Gibson borrowed $270 from the personal loan department of a bank. He agreed to repay the loan in 12 equal monthly payments of $22.50. The bank required Mr. Gibson to secure two co-signers for his note. The note was discounted at the rate of 4 per cent at the time the loan was made.

a. Find the amount of interest Mr. Gibson had to pay.

b. Find the amount of money Mr. Gibson received from the bank.

c. What was the true rate of interest?

3. Mrs. Bower, in order to pay cash for an electric refrigerator, borrowed $250 from a bank. She agreed to repay the loan in 10 equal monthly payments of $25 each. At the time the loan was made, the note was discounted at 5 per cent a year.

a. How much interest was paid on the loan?

b. How much money did Mrs. Bower actually receive from the bank?

c. How much money did she pay back to the bank?

d. Find the true rate of interest.

4. Robert Springer borrowed $150 from a bank. He agreed to repay the loan in 6 monthly installments of $25 each. At the time the loan was made, the note was discounted at the rate of 6 per cent a year.

a. How much interest was paid on the loan?

b. How much money did Mr. Springer actually receive?

c. How much money did he pay back?

d. What was the true rate of interest?

5. Wishing to pay cash for the balance due on an automobile he had purchased, George Lander borrowed $840 from the personal loan department of a bank. As security for the loan he gave a mortgage on his new car. The note was discounted at $4\frac{1}{2}$ per cent per year when the loan was made. Mr. Lander agreed to pay off the loan in 15 equal monthly payments.

a. How much interest did he pay?

b. How much money did Mr. Lander receive from the bank?

c. What was the amount of each monthly payment?
d. Find the true rate of interest.

6. Mr. Roberts borrowed $350 to pay a hospital bill, giving a mortgage on his automobile as security. The note was discounted at the rate of 6 per cent a year, and the loan was to be repaid in 8 equal monthly payments.

a. How much interest did Mr. Roberts pay?
b. How much money did he actually receive from the bank?
c. What was the amount of each monthly payment?
d. Find the true rate of interest.

7. In a certain community, an industrial bank discounts notes on automobile loans at 7 per cent per year. Mr. Buck signs a note for $800 to be repaid in 8 equal monthly payments.

a. How much money does he receive?
b. What real rate of interest does he pay?

8. A factory worker needed money to pay the expenses of moving to another city. He borrowed $150 from an industrial bank to be repaid in 5 equal monthly payments. His note was discounted at the rate of 5 per cent per year.

a. How much money did he receive?
b. What true rate of interest did he pay?

9. Mrs. Cooper borrowed $150 from an industrial bank. The bank deducted $10.50 when the loan was made. Mrs. Cooper paid the bank $12.50 every month for 12 months.

a. How much did Mrs. Cooper actually receive from the bank?

b. What was the rate of discount? (*Hint:* Find what per cent of the amount of the loan was deducted.)

c. What was the true rate of interest?

10. The sum of $360 was borrowed from the personal loan department of a large city bank. The bank deducted $14.40 when the loan was made. The loan was repaid in 12 monthly payments of $30 each.

a. What amount did the borrower receive?

b. At what rate was his note discounted? (*Hint:* Find what per cent of the loan was deducted.)

c. Find the true rate of interest.

Small Loans

Although the term "small loans" is sometimes applied to amounts as large as $1000, it is more commonly used to mean loans of $300 or less. The rate of interest on small loans is usually expressed in *per cent per month*, and in figuring interest payments, time is considered in months, rather than in years.

Interest = Principal × rate per month × time in months.

Credit Unions

Credit unions, like banks and insurance companies, have money to lend — the money they receive from the sale of stock. They lend this money to members who request loans. Loans up to $50 are ordinarily made without security; for loans over $50, some kind of collateral or the signature of a co-maker may be required. The rate of interest usually does not exceed 1 per cent per month. These loans are most often repaid in equal monthly installments.

COURTESY OF WILLIAM FILENE'S SONS CO.

Members of a department store credit union line up to buy shares on pay day.

Example

A railroad engineer borrowed \$300 from a credit union of which he was a member. He gave a mortgage on his car as security for the loan. The loan was repaid in 12 equal monthly payments with interest at 1 per cent per month on the balance due. How much interest did he pay?

What to Do	How to Do It
(1) Find the amount of each monthly payment.	$\$300 \div 12 = \$25$
(2) Find the interest for the first month.	$P = \$300;\ r = .01;\ t = 1$ $I = P \times r \times t$ $I = \$300 \times .01 \times 1 = \$3.00$
(3) Find the interest for the last month.	$P = \$25;\ r = .01;\ t = 1$ $I = P \times r \times t$ $I = \$25 \times .01 \times 1 = \$.25$
(4) Find the average monthly interest.	$\$3.00 + \$.25 = \$3.25$ $\$3.25 \div 2 = \$1.625$
(5) Find the total interest.	$12 \times \$1.625 = \$19.50$ Answer

PROBLEMS

1. A member of a post office employees' credit union borrowed \$180 from the union. Each month he paid \$15 on the principal and 1 per cent interest on the balance due.

a. How many monthly payments did he have to make to repay the loan?

b. How much interest did he pay?

2. A firemen's credit union charges interest at $\frac{3}{4}$ per cent per month on loans. At this rate, what would be the cost of a \$100 loan paid off in 5 equal monthly payments?

3. Miss McNerny, a teacher, borrowed \$300 from the teacher's credit union of which she was a member. Every month for five months she paid \$25 on the principal and

1 per cent interest on the balance due. At the end of the sixth month, she paid the interest then due and repaid the loan in full. Find the total amount of interest that she paid.

4. Donald Starkey borrowed \$25 from a credit union on September 8. On September 28, he repaid the loan with interest at the rate of 1 per cent a month.

a. How many days did Mr. Starkey have the use of the \$25 he borrowed?

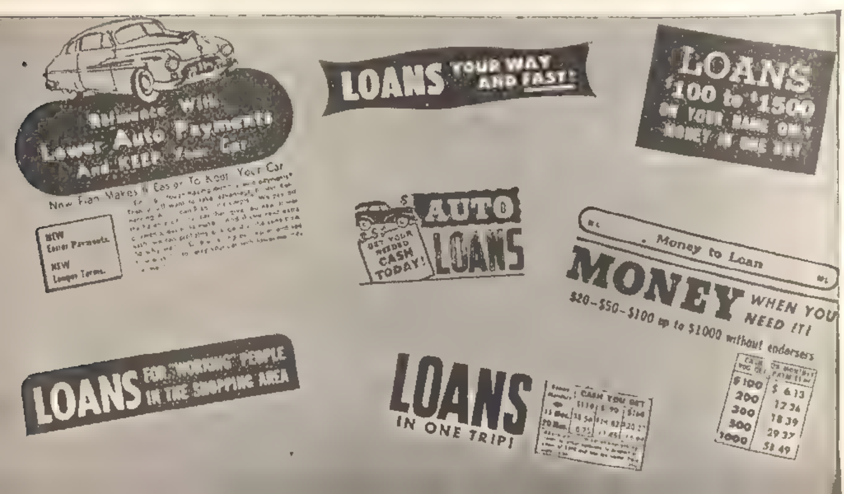
b. What fractional part of a month did he have the money? (30 days = 1 month)

c. How much interest did he have to pay on the loan?

5. James Tullis borrowed \$160 from a credit union on May 21. He repaid the loan as follows: June 20, \$50.00; July 28, \$50.00; August 20, the balance. The interest charged was 1 per cent a month on the balance due. Find the total cost of the loan.

Small Loan Companies

Probably you have seen advertisements of small loan companies (or personal finance companies). A small loan company will accept as security a mortgage on property such as household furniture, called a *chattel mortgage*, or may lend money on a person's signature alone. Since the risk involved in making such loans is great, the rate of interest is high. Most rates are from $1\frac{1}{2}$ to $3\frac{1}{2}$ per cent per month; that is, from 18 to 42 per cent per year. In all but a few of the states, the business of small loan companies is regulated by law.



These adverti... of small loan ... panies were fou... the classified c... of a morning ... paper.

Small loans are often arranged in such a way that the borrower pays back the same amount each month; some of his payment applies to the principal and some of it applies to the interest. This way of paying off a loan is called the *level-payment* method.

Table 18. MONTHLY PAYMENTS NECESSARY TO PAY OFF LOANS OF \$100 AND \$200 IN 6 TO 20 MONTHS AND LOANS OF \$500 AND \$1000 IN 6 TO 24 MONTHS

Cash You Get	*Months to Pay and Amount of Each Payment*			
	24	20	12	6
\$ 100		\$ 6.13	\$ 9.47	\$ 17.87
200		12.26	18.94	35.74
500	\$25.17	29.37	46.25	88.59
1000	50.13	58.49	92.09	176.35

Table 18 shows how loans of \$100 to \$1000 can be paid off according to the level-payment method. This table was copied from a street-car advertisement of a small-loan company. To see what interest a borrower actually pays, consider the case of a man who borrowed \$100 from this company and elected to pay his debt in 20 monthly installments of \$6.13.

Total amount of interest:

Monthly payment on principal: $\$100 \div 20 = \$\ 5$
Monthly payment on interest: $\$6.13 - \$5 = \$\ 1.13$

$$\begin{array}{r} \$\ 1.13 \\ \times\ 20 \\ \hline \$22.60 \end{array}$$

Average debt:

Debt the first month: \$100
Debt the last month: + 5

$$\begin{array}{r} \$100 \\ +\quad 5 \\ \hline \$105 \end{array} \div 2 = \$52.50$$

Average debt × time in years: $\frac{20}{12} \times \$52.50 = \$87.50$

True rate of interest = Amount of interest ÷ product:

$$\$22.60 \div \$87.50 = .2582 = 25.8\%$$

Example

What is the true annual rate of interest on a loan of $200 that is repaid in six monthly installments of $35.74 each?

What to Do	How to Do It
(1) Find the amount of the principal that is repaid each month.	$200 ÷ 6 = $33.33
(2) Find the amount of each payment that represents interest.	$35.74 − $33.33 = $2.41
(3) Find the total amount of interest.	6 × $2.41 = $14.46
(4) Find the average debt.	Debt the first month: $200 Debt the last month: 33.33 $233.33 ÷ 2 = $116.67
(5) Find the true rate of interest: divide the amount of interest by the product of the average debt and the time.	$\frac{6}{12}$ × $116.67 = $58.33 $14.46 ÷ $58.33 = .2478 .2478 = 24.8% Answer

PROBLEMS

Refer to Table 18 as you solve these problems.

1. What is the annual rate of interest on a loan of $100 that is repaid in twelve monthly installments of $9.47 each?

2. Find the annual rate of interest on a loan of $1000 repaid in twenty monthly installments according to the level-payment outlined in Table 18.

3. Mr. Martin borrowed $75 from a small-loan company, and repaid it in fifteen monthly installments of $6.06 each.

a. How much did the loan cost him?

b. What annual rate of interest did he pay?

4. Mrs. Barnhart borrowed $100 from a personal finance company. She cancelled the debt by paying $6.97 monthly for 18 months. What annual rate of interest did she pay?

5. Mr. Taylor borrowed $175 from a personal finance company. He paid off his debt in nine monthly installments of $21.96 each. Find the annual rate of interest.

Pawnbrokers

Pawnbrokers are to be found in every large city. A pawnbroker lends money on personal possessions, such as cameras, tools, jewelry, and clothing. When a person pawns something, he leaves it as security for a loan. If he does not redeem it by repaying the loan with interest, the pawnbroker may sell it.

A pawnbroker's rates are limited either by state or city law. Usually he may charge between $2\frac{1}{2}$ and 10 per cent per month. This high rate of interest is permitted because of the large risk a pawnbroker takes.

The overcoat that the man is examining, like the articles in the pawnshop window, was left as security for a loan that was never repaid.

GALLOWAY

PROBLEMS

1. When Mr. Brown was out of work, he borrowed $65 from a pawnbroker, pledging some jewelry as security. At the end of the month, being unable to repay the loan in

full, he paid the interest and $35 on the loan. At the end of the second month he managed to pay the loan in full. He was charged interest at the rate of $3\frac{1}{2}$ per cent per month. How much did the loan cost him?

2. Ralph Messner moved to a city at some distance from his home and there he secured a job in a factory. After working for several weeks, he became ill and had to spend all his savings for doctor bills. To pay his expenses until he could go back to work, he borrowed $25 from a pawnbroker, giving his watch and an overcoat as security for the loan. At the end of a month, being unable to repay the loan, he paid only the interest. At the end of the second month, he repaid the loan in full. The rate of interest charged was 6 per cent a month.

a. How much interest did he have to pay at the end of the first month?

b. How much did he have to pay the pawnbroker at the end of the second month to redeem his watch and overcoat?

3. Harry Green borrowed $15 from a pawnbroker, giving his watch as security. He paid 5 per cent per month as interest. He redeemed the watch ten days later. How much did he have to pay at that time? (1 month = 30 days)

4. Mr. Lopez pawned his camera for $60 and at the end of one month redeemed the camera by paying $61.80.

a. How much interest was he charged?

b. At what annual rate of interest was he charged?

5. A waitress, temporarily out of a job, pawned her diamond ring for $35. At the end of 3 weeks she redeemed the ring by paying $36.05.

a. How much interest was she charged for the loan?

b. How much interest per week was she charged?

c. At what annual rate of interest was she charged?

Illegal Money Lenders

In most cities there are persons known as *loan sharks*, who make a business of lending small sums of money illegally. They are not licensed and often charge an extremely high rate

of interest — sometimes as much as 10 or 20 per cent *per week!* Twenty per cent per week is over 1000 per cent per year.

The loan shark may operate on a street corner near a large factory or a college. Or he may run a small store as a blind for his money-lending activities. He lends small sums for a short time, perhaps a week, or until the borrower's next pay day. For example, he may give a man $10 on Monday, provided he is paid $11 on Saturday. That is, he charges $1.00 for less than a week's use of $10. This interest represents more than 10 per cent per week, or over 520 per cent per year.

Example

Albert Lenz, having spent his wages foolishly, needed money to pay for his room and board. He borrowed $25 from an unlicensed lender. One week later, he repaid the loan in full by a payment of $27.00. What annual rate of interest was charged?

What to Do	How to Do It
(1) Find the amount of the interest.	$\$27 - \$25 = \$2$
(2) Multiply the debt by the length of time in years.	$t = 1 \text{ week} = \frac{1}{52} \text{ year}$ $\frac{1}{52} \times \$25 = .48$
(3) Divide the amount of interest by the product.	$2 \div .48 = 4.166 = 416.6\%$ Answer

PROBLEMS

1. An illegal lender will lend you $5 on Monday provided you pay back $6 on Friday. What annual rate of interest does he charge? (Consider 360 days equal to 1 year)

2. Mrs. Horton borrowed $25 from a loan shark. She was supposed to pay him $30 one week later. However, at the end of the week she could not raise the $30 so she made arrangements to pay $36 at the end of the following week.

a. How much interest was she charged for the two weeks?
b. What annual rate of interest was she charged? (52 weeks = 1 year)

3. William Thompson could not secure a loan from a legal loan company so he borrowed \$20 from a lender who operated unlawfully. Once a month for several months, the lender charged him \$2 interest and renewed the loan for \$20. What rate of interest per year was Mr. Thompson paying?

4. An illegal lender let a man have \$25 on the condition that he pay \$2.50 a week interest. Each week for a year the borrower paid \$2.50 interest and renewed his note for \$25. At the end of the year he still owed the \$25.
a. How much interest did he pay for the use of \$25 for one year?
b. What per cent of the amount borrowed was this?

5. A dishwasher in a restaurant borrowed \$30 from an illegal lender. He repaid the loan by making 3 monthly payments of \$13 each.

a. How much interest did he pay?
b. What annual rate of interest did he pay?

What You Have Learned in This Chapter

1. To figure the interest on a loan, whether repaid in one sum or in installments
2. To determine the true rate of interest on discounted notes
3. To figure the true rate of interest on a loan repaid according to the level-payment plan
4. The kinds of lending agencies from which a person may borrow money. (These are listed in Table 19.)
5. To calculate the rates of interest charged by loan sharks
6. To understand and use correctly the following terms: *promissory note, maker, co-maker, security, collateral, mortgage, character loan, chattel mortgage, small loan company, pawnbroker*

Table 19. LENDING AGENCIES ACCORDING TO SECURITY REQUIRED, INTEREST RATES, AND METHOD OF REPAYMENT

Lending Agency	*Security Required*	*Usual Charge*	*Method of Repayment*
Bank	Real estate, stocks and bonds, cash value of life insurance policy, personal note, co-maker note, sometimes mortgage on automobile.	Interest of 4% to 6% per year *or* Discount of 4% to 8% per year; sometimes plus investigation fee of 1% to 2% and/or life insurance fee of $\frac{3}{4}$%	Lump sum, plus interest Regular installments, each plus interest *or* Equal monthly installments
Life insurance company	Cash value of life insurance policy	Interest of 5% to 6% per year	Lump sum, plus interest *or* Part payments, plus interest, at regular or irregular intervals
Credit union (members only)	Borrower's signature, co-maker note, chattel mortgage, shares of credit union stock	Interest of 1% per month	Monthly installments, plus interest
Small loan company	Chattel mortgage, co-maker note, borrower's signature	Interest of $1\frac{1}{2}$% to $3\frac{1}{2}$% per month; rates may vary with amount borrowed	Equal monthly payments, including interest (level-payment method) *or* Monthly installments, plus interest
Pawnbroker	Personal property	Interest of $2\frac{1}{2}$% to 10% per month	Lump sum, plus interest

Review Test on Borrowing

1. A life insurance company makes loans secured by the cash value of its policies at 6 per cent interest. Find the cost of a loan of $275 repaid in full at the end of 8 months.

2. Allen Potter borrowed $900 from a bank at 4 per cent interest per year. He gave a mortgage on his livestock as security. He paid $300 plus interest every three months until the loan was repaid. How much interest did Mr. Potter pay on the loan?

3. John Henricks, a farmer, borrowed $475 from a bank, giving a mortgage on his livestock as security. The rate of interest charged was 5 per cent. At the end of 6 months he paid the interest due and $175 on the principal. At the end of 12 months he again paid the interest due and $175 on the principal. Six months later he repaid the loan in full. What was the total cost of the loan?

4. Mrs. Griffin borrowed $250 from the personal loan department of a bank. The loan was to be repaid in 10 monthly installments of $25 each. At the time the loan was made, the note was discounted at the rate of 6 per cent per year.

a. How much interest did Mrs. Griffin have to pay?
b. How much money did she receive from the bank?
c. What true rate of interest did she pay?

5. Mr. Rutledge borrowed $420 to pay for a used car that he had purchased. At the time the loan was made, the bank discounted the note at the rate of 5 per cent per year. Mr. Rutledge paid the bank $35 a month for 12 months. What true rate of interest did Mr. Rutledge pay?

6. Mr. Bancroft borrowed $200 from an industrial bank, agreeing to repay it in 10 equal monthly installments. The bank discounted his note at an annual rate of 6 per cent.

a. How much interest did Mr. Bancroft have to pay?
b. How much money did Mr. Bancroft receive from the bank?
c. What was the amount of each monthly payment?
d. Find the true rate of interest on the loan.

7. A loan of $180 was obtained from a credit union that charges 1 per cent a month interest on the balance due of the loan. The loan was repaid in 12 equal monthly payments. How much interest was paid on the loan?

8. What is the true annual rate of interest on a $500 loan that is repaid in 20 monthly installments of $29.37 each?

9. James Stillman borrowed $45 from a pawnbroker, giving a diamond ring as security. The loan was repaid at the end of 1 month. The interest charge was 3 per cent a month. What was the cost of the loan?

10. Find the annual rate of interest charged by a loan shark who charged $3 for a loan of $25 for 1 week.

How do you rate?	Excellent	Good	Fair	Poor
	9–10	7–8	6	5 or less

Check-Up Tests on Computation

These tests match those at the end of Unit Two. You should be able to do all the computations accurately and rapidly. If you find any difficulty, turn back to Chapter 2 and study the operations you find hard.

TEST ON WHOLE NUMBERS

Find these sums:

1)	**2)**	**3)**	**4)**	**5)**
250	382	926	128	250
26	904	560	48	32
169	81	7025	347	469
96	74	30	18	76
458	670	14	236	358

6)	**7)**	**8)**	**9)**	**10)**
6017	139	3028	261	393
165	543	654	6015	93
36	58	147	570	892
9	287	98	85	763
25	47	36	69	81

11)	**12)**	**13)**	**14)**	**15)**
815	239	371	493	8017
671	237	321	109	459
14	58	70	92	36
41	307	465	43	29
903	47	69	1	125
			680	

16)	**17)**	**18)**	**19)**	**20)**
392	604	916	805	604
10	82	76	987	5098
81	703	825	14	703
250	52	10	21	32
4	892	914	803	92
570				

Find these differences:

21) 90813
 14067

22) 93295
 24309

23) 70218
 14657

24) 30909
 28857

25) 82184
 24359

26) 86729
 18059

27) 91234
 11067

28) 67807
 48659

29) 55562
 48359

30) 94796
 48357

31) 81372
 48367

32) 73470
 48359

33) 64037
 21057

34) 40690
 23367

35) 59651
 28057

36) 912816
 28309

37) 304045
 24367

38) 702361
 11069

39) 645458
 21069

40) 714503
 21069

Find these products:

41) 34
 47

42) 56
 74

43) 14
 68

44) 910
 32

45) 842
 23

46) 546
 90

47) 20
 47

48) 87
 74

49) 1230
 90

50) 28
 86

51) $\begin{array}{r}346\\ \underline{51}\end{array}$ **52)** $\begin{array}{r}2089\\ \underline{15}\end{array}$ **53)** $\begin{array}{r}60\\ \underline{86}\end{array}$ **54)** $\begin{array}{r}19\\ \underline{47}\end{array}$ **55)** $\begin{array}{r}36\\ \underline{23}\end{array}$

56) $\begin{array}{r}57\\ \underline{68}\end{array}$ **57)** $\begin{array}{r}39\\ \underline{68}\end{array}$ **58)** $\begin{array}{r}75\\ \underline{32}\end{array}$

59) $\begin{array}{r}157\\ \underline{15}\end{array}$ **60)** $\begin{array}{r}789\\ \underline{90}\end{array}$

Find the following quotients:

61) $47\overline{)4378}$

62) $19\overline{)1503}$

63) $74\overline{)4588}$

64) $91\overline{)3276}$

65) $56\overline{)3402}$

66) $65\overline{)2925}$

67) $19\overline{)1002}$

68) $47\overline{)3298}$

69) $74\overline{)3330}$

70) $19\overline{)342}$

71) $47\overline{)3840}$

72) $91\overline{)3690}$

73) $30\overline{)27,720}$

74) $82\overline{)73,882}$

75) $56\overline{)10,829}$

76) $30\overline{)15,300}$

77) $65\overline{)18,655}$

78) $28\overline{)15,344}$

79) $30\overline{)235,890}$

80) $28\overline{)188,496}$

How do you rate?	Excellent	Good	Fair	Poor
	79–80	75–78	70–74	69 or less

TEST ON COMMON FRACTIONS

Give each sum in its lowest terms:

1) $\frac{2}{5} + \frac{2}{5}$

2) $\frac{5}{12} + \frac{1}{12}$

3) $\frac{3}{10} + \frac{3}{10}$

4) $\frac{5}{6} + \frac{1}{6}$

5) $\frac{4}{5} + \frac{2}{5}$

6) $\frac{7}{10} + \frac{9}{10}$

7) $3\frac{1}{4} + 7\frac{1}{4}$

8) $4\frac{5}{16} + 5\frac{3}{16}$

9) $\begin{array}{r} 5\frac{1}{4} \\ \underline{3} \end{array}$

10) $\begin{array}{r} \frac{5}{6} \\ \underline{\frac{2}{3}} \end{array}$

11) $\begin{array}{r} \frac{1}{2} \\ \underline{\frac{7}{12}} \end{array}$

12) $\begin{array}{r} \frac{3}{5} \\ \underline{\frac{7}{10}} \end{array}$

13) $\begin{array}{r} 12\frac{7}{8} \\ \underline{8\frac{3}{4}} \end{array}$

14) $\begin{array}{r} 7\frac{7}{16} \\ \underline{5\frac{5}{8}} \end{array}$

15) $\begin{array}{r} \frac{3}{8} \\ \underline{\frac{1}{3}} \end{array}$

16) $\begin{array}{r} \frac{2}{3} \\ \underline{\frac{4}{5}} \end{array}$

17) $\begin{array}{r} 7\frac{1}{2} \\ \underline{8\frac{1}{3}} \end{array}$

18) $\begin{array}{r} 10\frac{4}{5} \\ \underline{8\frac{1}{2}} \end{array}$

19) $\begin{array}{r} 15\frac{2}{3} \\ \underline{6\frac{3}{4}} \end{array}$

20) $\begin{array}{r} 14\frac{3}{4} \\ \underline{9\frac{5}{6}} \end{array}$

Give each difference in its lowest terms:

21) $\frac{2}{3} - \frac{1}{3}$

22) $\frac{11}{12} - \frac{1}{12}$

23) $\frac{17}{24} - \frac{13}{24}$

24) $10\frac{13}{16} - 4\frac{9}{16}$

25) $10\frac{3}{8} - 4\frac{1}{8}$

26) $20\frac{4}{5} - 17$

27) $6\frac{7}{10} - \frac{1}{10}$

28) $10 - \frac{1}{3}$

29) $\begin{array}{r} 13 \\ 9\frac{2}{5} \\ \hline \end{array}$

30) $\begin{array}{r} 15\frac{1}{8} \\ 7\frac{3}{8} \\ \hline \end{array}$

31) $\begin{array}{r} 10\frac{5}{12} \\ 4\frac{7}{12} \\ \hline \end{array}$

32) $\begin{array}{r} \frac{5}{8} \\ \frac{1}{2} \\ \hline \end{array}$

33) $\begin{array}{r} \frac{3}{4} \\ \frac{5}{12} \\ \hline \end{array}$

34) $\begin{array}{r} 19\frac{5}{6} \\ 7\frac{1}{2} \\ \hline \end{array}$

35) $\begin{array}{r} 18\frac{3}{4} \\ 12\frac{7}{8} \\ \hline \end{array}$

36) $\begin{array}{r} 15\frac{3}{10} \\ 12\frac{1}{2} \\ \hline \end{array}$

37) $\begin{array}{r} 10\frac{5}{8} \\ 3\frac{2}{3} \\ \hline \end{array}$

38) $\begin{array}{r} 25\frac{1}{5} \\ 17\frac{2}{3} \\ \hline \end{array}$

39) $\begin{array}{r} 20\frac{3}{4} \\ 10\frac{4}{5} \\ \hline \end{array}$

40) $\begin{array}{r} 13\frac{1}{6} \\ 10\frac{1}{2} \\ \hline \end{array}$

Give each product in its lowest terms:

41) $\frac{1}{8}$ of 56

42) $\frac{1}{10}$ of \$2.40

43) $\frac{1}{6}$ of 144

44) $\frac{3}{4}$ of 48

45) $\frac{3}{8}$ of 5

46) $\frac{5}{6}$ of 75

47) $21 \times \frac{5}{8}$

48) $\frac{7}{8} \times \frac{3}{5}$

49) $\frac{3}{8} \times \frac{2}{3}$

50) $\frac{9}{10} \times \frac{1}{12}$

51) $45 \times 1\frac{1}{3}$

52) $400 \times 5\frac{3}{4}$

53) $6\frac{1}{4} \times \frac{1}{8}$

54) $3\frac{2}{3} \times 6$

55) $18\frac{2}{5} \times 25$

56) $3\frac{1}{8} \times 1\frac{1}{5}$

57) $2\frac{3}{4} \times 1\frac{1}{2}$

58) $2\frac{2}{3} \times 2\frac{1}{10}$

59) $2\frac{1}{3} \times 3\frac{3}{5} \times \frac{5}{6}$

60) $5\frac{3}{4} \times 4\frac{4}{5} \times 2\frac{1}{2}$

Give each quotient in its lowest terms:

61) $5 \div \frac{2}{3}$

62) $7 \div \frac{3}{4}$

63) $5 \div \frac{5}{6}$

64) $\frac{1}{2} \div \frac{1}{2}$

65) $\frac{2}{5} \div \frac{1}{6}$

66) $\frac{3}{10} \div \frac{3}{8}$

67) $\frac{9}{10} \div \frac{9}{16}$

68) $\frac{7}{8} \div 14$

69) $\frac{3}{4} \div 12$

70) $\frac{2}{3} \div 6$

71) $2\frac{3}{8} \div 2$

72) $2\frac{1}{4} \div \frac{1}{3}$

73) $3\frac{1}{8} \div 5$

74) $20 \div 1\frac{1}{3}$

75) $\frac{2}{5} \div 2\frac{1}{2}$

76) $3 \div 2\frac{1}{2}$

77) $\frac{5}{6} \div 4\frac{2}{3}$

78) $3\frac{1}{3} \div 2\frac{1}{6}$

79) $3\frac{3}{4} \div 5\frac{1}{2}$

80) $5\frac{3}{4} \div 3\frac{3}{8}$

How do you rate?	Excellent	Good	Fair	Poor
	79–80	75–78	70–74	69 or less

TEST ON DECIMAL FRACTIONS

Add each of the following groups of decimal fractions:

1) .1, .2, .3
2) .6, .5, .9
3) .15, .43, .12
4) .19, .26, .37
5) .01, .29, .44
6) .12, .74, .18, .96
7) .20, .94, .10, .76
8) .89, .79, .65, .56
9) .325, .048, .005
10) .648, .729, .345
11) 1.9, 2.4, 6.5
12) 7.1, 3.5, 6.9
13) 2.29, .24, 8.75
14) 7.15, 6.93, 77.04
15) 5, 3.5, 4.2
16) 8.9, 7.4, 6.3
17) 87.27, 2.64, 64.89
18) 8, .08, 39.27
19) 6.595, .676, 7.053
20) .508, 8.348, .556

Subtract the smaller number from the larger in each pair of numbers:

21) .5, .4
22) .15, .36
23) .74, .75
24) .79, .86
25) .54, .49
26) 2.8, 5.6
27) 27.3, 9.3
28) 53.56, 37.81
29) 10.9, 9
30) 6, 7.1
31) 75, 92.4
32) 3.8, 37
33) 6, .04
34) 10.045, 10.405
35) 36, 30.36
36) 200, 17.95
37) 87.5, 90
38) .04, .064
39) .0334, .0341
40) 4.276, .537

Multiply:

41) $\begin{array}{r} .6 \\ \underline{3} \end{array}$

42) $\begin{array}{r} 48 \\ \underline{.7} \end{array}$

43) $\begin{array}{r} .15 \\ \underline{5} \end{array}$

44) $\begin{array}{r} 36 \\ \underline{.14} \end{array}$

45) $\begin{array}{r} .615 \\ \underline{6} \end{array}$ **46)** $\begin{array}{r} 475 \\ \underline{.005} \end{array}$ **47)** $\begin{array}{r} .6 \\ \underline{.8} \end{array}$ **48)** $\begin{array}{r} .84 \\ \underline{.7} \end{array}$

49) $\begin{array}{r} .09 \\ \underline{.4} \end{array}$ **50)** $\begin{array}{r} .46 \\ \underline{.5} \end{array}$ **51)** $\begin{array}{r} .05 \\ \underline{.09} \end{array}$

52) $\begin{array}{r} 8.7 \\ \underline{3.4} \end{array}$ **53)** $\begin{array}{r} .67 \\ \underline{5.4} \end{array}$

54) $\begin{array}{r} 240 \\ \underline{.03} \end{array}$ **55)** $\begin{array}{r} 720 \\ \underline{.035} \end{array}$ **56)** $\begin{array}{r} .072 \\ \underline{480} \end{array}$

57) $\begin{array}{r} 304.5 \\ \underline{.65} \end{array}$ **58)** $\begin{array}{r} 5.96 \\ \underline{7.3} \end{array}$ **59)** $\begin{array}{r} 37.95 \\ \underline{.15} \end{array}$ **60)** $\begin{array}{r} 495.65 \\ \underline{.20} \end{array}$

Divide:

61) $4\overline{).8}$

62) $9\overline{).36}$

63) $7\overline{).056}$

64) $6\overline{)13.8}$

65) $36\overline{).864}$

66) $34\overline{)9.18}$

67) $43\overline{)309.6}$

68) $72\overline{)3.24}$

69) $5\overline{)3}$

70) $35\overline{)14}$

71) $10\overline{)8.3}$

72) $100\overline{)5.4}$

73) $1000\overline{)84.5}$

74) $.7\overline{).84}$

75) $.09\overline{).486}$

76) $4.6\overline{)17.02}$

77) $19.2\overline{)49.92}$

78) $12.5\overline{)150}$

79) $3.4\overline{)19.62}$

80) $8.07\overline{)56.43}$

How do you rate?	Excellent	Good	Fair	Poor
	79–80	75–78	70–74	69 or less

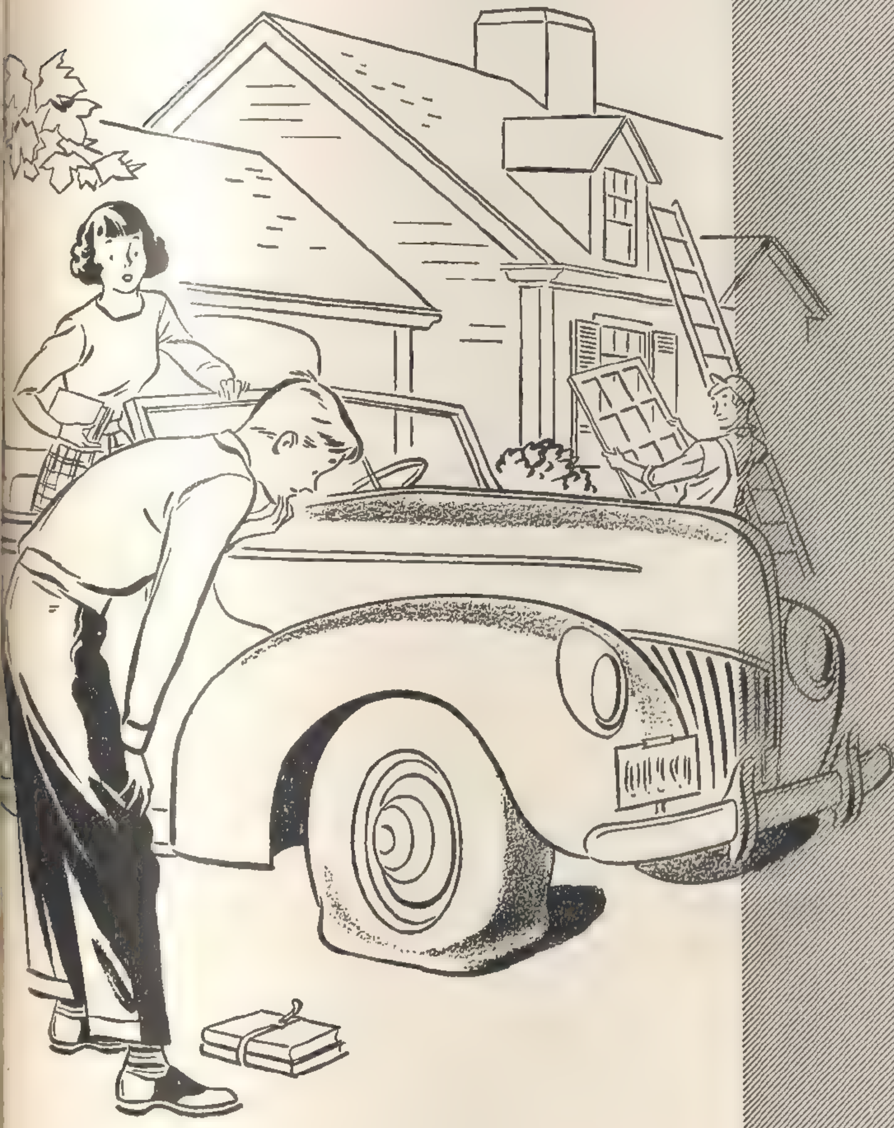
TEST ON PER CENTS

1) 5 is 1% of what number?
2) 25 is 5% of what number?
3) 85 is 17% of what number?
4) 250 is 125% of what number?
5) 450 is 15 per cent of what number?
6) 1825 is 25 per cent of what number?
7) 18 is 200% of what number?
8) 75 is $33\frac{1}{3}$% of what number?
9) 300% of what number is equal to 66?
10) 3 is .5% of what number?
11) 20 is $\frac{1}{4}$% of what number?
12) 250 is 62.5% of what number?
13) 36 is 75% of what number?
14) 96 per cent of what number is equal to 432?
15) 1476 is 48 per cent of what number?
16) 40 is 20% less than what number?
17) 375 is 25 per cent more than what number?
18) $29.75 is 15 per cent less than what amount?
19) $201.60 is 12 per cent more than what amount?
20) 5628 is .5% more than what number?

How do you rate?	Excellent	Good	Fair	Poor
	20	18–19	16–17	15 or less

UNIT FOUR

Shelter, Travel and Taxes



CHAPTER

11

ROBERTS

1. From some home owners whom you know well, find out how much each spends on keeping up his house. What jobs must be done to keep a house in good condition?
2. Find out the prices of some of the houses for sale in your community. Find out the assessed valuations of the same houses.
3. Learn the tax rate in your community for the current year. Is it different from last year's tax rate? Try to account for the difference.

OWNING YOUR HOME

WHETHER A FAMILY owns the house in which it lives or pays rent for a house or apartment, the money spent for shelter is one of the main items in the family budget. The average family spends about one dollar out of every four or five for shelter.

The Cost of Shelter

The expenses connected with owning a house include real estate taxes, insurance premiums, and the cost of repairs and keeping up the appearance of the house. As a house gets older, it decreases in value; so *depreciation* must be considered an expense of owning the property. In addition, there is the loss of interest that might be earned on the money invested in the house. For example, if the owner of a house were to sell it for $10,000, he could invest his money and receive, say, 3 per cent per year in interest. So one of his expenses of owning the house is the $300 he doesn't get as interest money.

Renting Versus Owning Your Home

No doubt you have heard arguments about whether it is better to rent a house or buy one. There are many factors that enter into such a decision: the kind of job you have, the size of the family, the availability of houses, and so on. Cost is one important consideration.

Example

Mr. and Mrs. Walton live in a house for which they pay \$65 a month rent to the owner, Mr. Moore. Last year Mr. Moore had the following expenses on the house: taxes, \$113.40; fire insurance, \$11.80; maintenance, \$138.00. The house is valued at \$7000. Depreciation is 2 per cent per year. If Mr. Moore were to sell the house, the \$7000 he would receive could be invested at 3 per cent annual interest. Which is more and how much more, the monthly rent that the Waltons pay or the monthly cost of the house to Mr. Moore?

What to Do	How to Do It
(1) Add the owner's annual expenses, including the loss of interest that might be earned on the money invested in the house.	\$113.40 11.80 138.00 140.00 .03 × \$7000 = 210.00 \$613.20
(2) Find the average monthly expense of the house to the owner.	\$613.20 ÷ 12 = \$51.10
(3) Find the difference between the average monthly expense to the owner and the rent the tenants pay.	\$65.00 − \$51.10 = \$13.90, amount by which monthly rent exceeds monthly cost to owner

PROBLEMS

1. The Mortons pay \$75 a month rent for a house valued at \$8500. The owner has these average annual expenses: taxes, \$171.65; fire insurance, \$18.90; and upkeep, \$185.00. He figures depreciation at 2 per cent of the value of the house. If he were to sell the house, the \$8500 he would get for it would earn $2\frac{1}{2}$ per cent per year (simple interest). Which is more, and how much more, the monthly rent or the monthly cost of owning the house?

2. Mr. Hall rents a brick house for $70 a month. The owner has offered to sell the house to him for $9500. Mr. Hall has $9500 in his bank account, earning interest at $2\frac{1}{2}$ per cent per year, compounded semiannually. He finds that the taxes on the house average $243.44 annually, and that the insurance premiums amount to $16.87 annually. He estimates that the repairs needed during the next five years should cost not more than $750, and figures depreciation at 1 per cent of the purchase price per year.

GALLOWAY

The cost of painting a house is one of the items included under "maintenance." Paint protects the wood of which the house is constructed, as well as improving the general appearance.

a. How much does Mr. Hall pay as rent each year?

b. How much annual interest does he receive on $9500? (*Hint:* See page 296 or page 299.)

c. If he should buy the house, how much might he expect it to cost him annually in taxes, maintenance expense, interest, insurance premiums, and depreciation?

d. Which would cost Mr. Hall less per year, and how much less, the rent he is paying or the expenses of owning the house?

3. The Linders have just rented a new house for which they pay $52.50 a month. The owner of the house has offered to sell it to them for $6250. If the Linders decide to buy the house, they will redeem some bonds they own and pay cash for the house. These bonds earn $2\frac{1}{2}$ per cent interest. The taxes on the house and lot this year are $137.80. Insurance costs $11.30 a year. Mr. Linder has estimated that the annual depreciation on the house will average 2 per cent of the cost of the house and lot and that the cost of upkeep per year will average $1\frac{1}{2}$ per cent of the cost of the house and lot.

GALLOWAY

An old house may need re-roofing. When fireproof shingles are used, the cost of fire insurance is less than when wood shingles are used.

a. If the Linders buy the property, what will it cost them annually to own the house and lot? (Remember to include the loss of interest on the bonds as part of the expense of ownership.)

b. Which is less per year and how much, the cost of owning the home or the rent?

4. Mr. and Mrs. Miller are paying \$45 a month rent for the house in which they live. Recently, the owner of the house offered to sell it to Mr. Miller for \$5000. The tax bill on the property last year was \$66.90. The house is insured for \$3500 at \$.16 per \$100 annually. The cost of the upkeep averages \$125 a year. As the house gets older, its value decreases about \$125 a year. If Mr. Miller buys the property, he will take \$2000 from his savings account for a down payment. This money is now earning $2\frac{1}{2}$ per cent interest per year, compounded semiannually. He will have to borrow \$3000 at 5 per cent interest per year.

a. If Mr. Miller should spend his \$2000 on the house, what would be the loss in interest each year? (*Hint:* See page 299.)

b. If Mr. Miller should borrow the \$3000 he needs, how much would it cost him in interest per year?

c. What is the annual cost of the taxes, insurance, maintenance, and depreciation of the house?

d. If Mr. Miller should buy the house, how much would it cost him per year to own it?

e. Which is more, and how much more, the rent Mr. Miller pays each month or the monthly cost of owning the house?

5. Mr. and Mrs. Harley pay \$125 a month rent. They could buy the property for \$9800. They have \$2000 in their

savings account, earning 2 per cent interest per year, compounded semiannually. They could borrow the remainder of the price at $4\frac{1}{2}$ per cent interest per year. The taxes on the property last year were $146.40. Fire insurance on the house costs $22.50 a year. The cost of upkeep per year would average $1\frac{1}{2}$ per cent of the cost of the property and the depreciation would average 2 per cent of the cost of the property each year. The Harleys decide to buy the house.

a. What will be the total cost of owning the house the first year? (*Hint:* Remember to add the loss of interest on the $2000 and the interest on the loan.)

b. How much will they save the first year by owning the house rather than renting it?

Taxes on Real Estate

Real estate is taxed to support the town or city in which the property is located. The home owner pays his real estate taxes directly to the town tax collector. The renter pays these taxes indirectly; that is, his landlord pays them out of the money received as rent. The person who actually pays the taxes — the owner of the property — may deduct them from his income when computing his income tax. The person whose taxes are hidden in his rent is not allowed to deduct them for income-tax purposes.

To find out what the taxes are on a piece of real estate, you must know two facts: the assessed valuation of the property and the *tax rate* of the community in which it is located.

The assessed valuation of a piece of property is a value placed on the property for tax purposes. It is not the same as the cost of the property or the price for which it could be sold; often it is about 60 per cent of the cost. The assessment is determined by an official of the town or city, called the *assessor*.

The tax rate varies from place to place. In a large city, for example, it is usually higher than in a suburb or a small town. The rate varies also from year to year. It is deter-

mined annually after the budgets for the schools and other parts of the local government have been prepared. Ordinarily the amount is from $1\frac{1}{2}$ to 4 per cent of the assessed valuation of the property.

The tax rate may be expressed in any one of several ways. All of the following are ways of stating the same tax rate:

As a per cent:	3.027%	In dollars per dollar:	\$.03027
In cents per dollar:	3.027	In dollars per \$100:	\$3.027
In mills per dollar:	30.27	In dollars per \$1000:	\$30.27
(10 mills = 1 cent)			

PROBLEMS

1. Express each of the following rates in dollars per \$100:

a. \$.0218 per dollar
b. 1.524 cents per dollar
c. 30.81 mills per dollar
d. \$29.85 per \$1000
e. 2.306 per cent

2. Express each of the following rates in dollars per \$1000:

a. \$.02827 per dollar
b. 2.856 cents per dollar
c. 16.10 mills per dollar
d. \$2.735 per \$100
e. 3.048 per cent

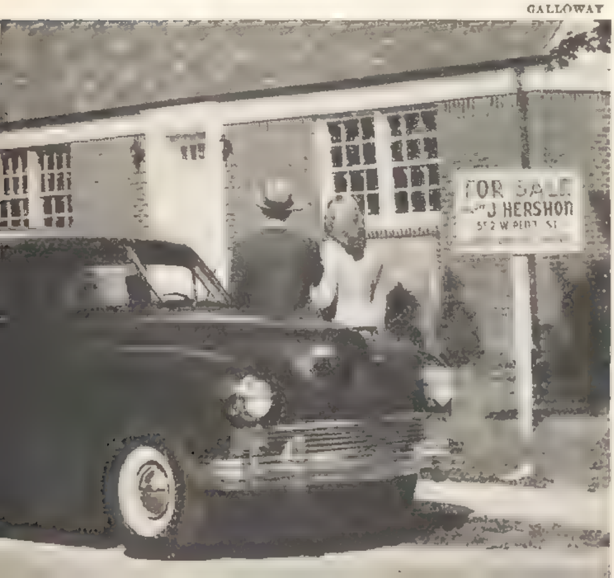
3. The assessed valuation of Mr. Armstrong's house is \$6300. What is his annual tax bill if the tax rate is \$28.725 per \$1000?

4. Mr. Farley's house is assessed at \$5400. Find his annual tax bill if the rate is \$2.86 per \$100.

5. The assessed valuation of Mr. Sandberg's house is \$7760. The annual tax rate is 24.92 mills per dollar, and taxes are payable twice a year. How much does Mr. Sandberg pay each time he pays his taxes?

When a couple decides to buy a house, they must bear in mind not only first cost, but the cost of upkeep. They should also have the advice of someone who knows when a house is well constructed.

GALLOWAY



This "modern" house can be heated much less expensively than a more conventional house in the same locality, for it is built to take advantage of the sun's rays.

6. The assessed valuation of Mr. Whitman's house is \$8400. The annual tax rate is 27.81 mills per dollar, and taxes are payable semiannually. How much tax does Mr. Whitman pay each half year?

7. Mr. Clark paid \$9500 for his house and lot. It is assessed at 55 per cent of its cost. What is Mr. Clark's annual tax bill if the tax rate is 2.843 per cent?

8. Mr. Stone's house, which cost him \$13,500, is assessed at 62 per cent of its value. What is Mr. Stone's annual tax bill if the tax rate is 3.28 per cent?

9. The Tuckers live in a town with a tax rate of \$.02874 per dollar. Their house is assessed at \$8000, their garage at \$450, and their land at \$925. Find their annual tax bill.

10. Mr. and Mrs. Spafford own a house assessed at \$7000, a barn assessed at \$500, and land assessed at \$2850. The tax rate is \$.02634. Find their annual tax bill.

How to Buy a Home

Few people have enough available money to pay cash for a house. Most houses are purchased with money borrowed from a bank or savings and loan association. Before lending money for this purpose, the lending agency may make an investigation, not only of the credit rating of the borrower, but also of the condition of the property he wants to buy. If the

at $8000. The monthly payments, including payment on the principal, interest, taxes, and fire insurance, are $60.

a. Is the price of the house and lot more or less than the amount recommended by budget experts?

b. Is the monthly payment on the house and lot more or less than the amount recommended by budget experts?

c. If you were Mr. or Mrs. Berger, would you decide to buy this house? Give your reasons.

10. Mr. Neeley has a monthly income of $325. He is interested in buying a house and lot for $11,000. The payments on the principal and interest would be $56.90 a month. The annual tax on this property is $219.40 and the fire insurance costs $17.80 a year.

a. Are the monthly payments on this property more or less than 25 per cent of Mr. Neeley's monthly income?

b. Is the cost of the property more or less than the amount that a budget expert would recommend?

c. If you were Mr. Neeley, would you decide to buy the house? Explain your answer.

The Down Payment

The time when most families want to buy a home is when the children are small. However, their expenses at this time are usually high, and their incomes are lower than they will be later. To assist young people to buy homes, the United States government, through the Federal Housing Administration, provides a plan by which a family may borrow up to 80 per cent or even 90 per cent of the value of a house and lot.

Under the FHA plan, the loans are actually made by banks, savings and loan associations, or other approved lending institutions. The FHA insures or guarantees payment of the loan. If the FHA is to guarantee a home loan, the house must meet FHA specifications. It must be well built, and it must be reasonably near transportation, schools, and stores.

In general, FHA loans are for not more than 80 per cent of the cost of a house and lot. The buyer must make a 20 per cent down payment. But if the total cost is $10,000 or less,

and the home is a new one to be occupied by the owner, the loan may be larger. In this case, the buyer may borrow 90 per cent of the first $6000 and 80 per cent of the rest of the cost. That is, he need make a down payment of only 10 per cent of the first $6000 plus 20 per cent of the remainder.

Example The Scotts want to buy a new house, built according to FHA specifications, for their own occupancy. The price is $8500. How much money do they need for the down payment?

What to Do	How to Do It
(1) Find 10% of the first $6000.	$.10 \times \$6000 = \$600$
(2) Find the difference between the price and $6000.	$\$8500 - \$6000 = \$2500$
(3) Find 20% of this difference.	$.20 \times \$2500 = \$500$
(4) Find the total amount needed.	$\$600 + \$500 = \$1100$ Answer

PROBLEMS

1. What is the smallest down payment possible on a house valued at $5000 when bought under the FHA plan?

2. Mr. Wallace wishes to buy a bungalow valued at $5500. How much money does he need under the FHA plan?

3. Mr. O'Neill is planning to apply for an FHA loan to buy a house valued at $8000. How much cash must he have for the down payment?

4. What is the smallest down payment possible on a house and lot valued at $9200 when bought under the FHA plan?

5. What is the smallest down payment permissible under the FHA on a house and lot worth $12,000?

6. Mr. Welch wants to buy a house priced at $16,000. If he gets an FHA loan, how much cash does he need for a down payment?

PROBLEMS

1. Mr. Warner bought a house for $8000, paying $4000 in cash and borrowing the remaining $4000 from a bank. He agreed to pay the bank $30.60 a month for 15 years. These monthly payments included interest at $4\frac{1}{2}$ per cent per year and payment on the principal.

a. For each of the first two payments, find what part was interest and what part was applied to principal.
b. How much was the principal reduced the first two months?

2. The Smith family decided to buy a lot and build a house on it. They had to borrow $9000 to complete the payment of the house and lot. They found that a payment of $56.97 a month would cover the interest charge of $4\frac{1}{2}$ per cent per year and would repay the loan in 20 years.

a. For each of the first two payments, find what part was interest and what part was payment on principal.
b. How much was the principal reduced the first two months?

3. The monthly payment on the principal and interest on a $6000 FHA loan, to be repaid in 10 years, is $62.22. The rate of interest on the loan is $4\frac{1}{2}$ per cent and the average monthly mortgage insurance premium is $1.19.

a. Find the total of the payments on the principal and interest for 10 years.
b. Find the total interest paid on the loan in 10 years.
c. Find the total of the mortgage insurance premiums for 10 years.

4. The monthly payment on the principal and interest on an FHA loan of $12,000 to be repaid in 15 years is $91.80. The average monthly mortgage insurance is $1.39.

a. Find the total of the payments on the principal and interest for 15 years.
b. Find the total amount paid in interest in 15 years.
c. Find the total of the mortgage insurance premiums for 15 years.

5. Mr. and Mrs. Richards bought a house and lot for $8000. They paid $2000 down and obtained an FHA loan for the balance. They agreed to pay off the loan in monthly payments of $54.21 over a period of 20 years. The payments were to include interest ($4\frac{1}{2}\%$ per year) and amortization, taxes, fire insurance premiums, and mortgage insurance at $\frac{1}{2}$ per cent per year. During the first six months, the Richards' monthly payment included $12.50 for taxes, $1.35 for fire insurance, and $2.38 for mortgage insurance.

a. During the six months, how much of each payment went for interest and how much for reducing the principal?

b. At the end of six months, how much did the Richards owe on their property?

Keeping the Interest Cost Low

There are three factors that determine how much money a borrower must pay as interest on his loan. One is the *interest rate.* If he is able to borrow money at $4\frac{1}{2}$ per cent per year, he pays less per year for the same loan than if he borrows at 5 or 6 per cent per year. The second factor is *the size of the loan.* If he is able to make a large down payment on his home, he need borrow less money and thus pay less interest than if he can make only a small down payment. The third factor is *the length of time for which he owes money.* The larger the monthly payments a borrower can make on his loan, the sooner he is out of debt and the less he pays as interest.

Table 20. MONTHLY PAYMENTS REQUIRED TO PAY OFF A LOAN OF $1000 IN TEN TO TWENTY-FIVE YEARS AT 4 TO 6 PER CENT ANNUAL INTEREST

Length of Loan	*Rate of Interest*			
	4%	$4\frac{1}{2}\%$	5%	6%
10 Years	$10.13	$10.37	$10.61	$11.11
15 Years	7.40	7 65	7.91	8.44
20 Years	6.06	6.33	6.60	7.17
25 Years	5.28	5.56	5.85	6.45

7. Mr. Noll plans to buy land priced at $1200 and to build a house on it that will cost $7500. He owns United States Savings Bonds with a cash value of $2009.02 at the present time.

a. Find the minimum down payment that Mr. Noll will have to make.

b. If he cashes his savings bonds, will he have enough money to carry out his plans?

8. Mr. Jackson owns a lot valued at $1000, on which he is planning to build a house that will cost $8500.

a. Find the minimum down payment required.

b. The $1000 invested in the lot may be used as part of the down payment. In addition to the lot, how much cash is required for the down payment?

9. Mr. Hayes has $1750 in cash and an income of $350 a month. He is thinking of buying a lot for $500 and building a house that costs $9700 on it.

a. Does he have enough cash for the down payment on an FHA loan? Explain by showing your calculations.

b. Is the cost of the house and lot more or less than $2\frac{1}{2}$ times Mr. Hayes' annual income?

10. The Wrights, who have an income of $500 a month, are very much interested in a new home they have seen that is priced at $18,500.

a. What is the minimum down payment that would be required on this home?

b. Is the cost of the home more or less than $2\frac{1}{2}$ times the Wrights' annual income?

Monthly Payments

When a bank or savings and loan association lends money for buying a home, it also arranges for *amortizing* the loan; that is, for paying it off. Usually payments are made every month for ten, fifteen, or twenty years.

The monthly payment covers interest to date plus something on the principal. In a great many cases the payment also in-

cludes one twelfth of the annual tax bill, one twelfth of the annual fire insurance premium, and one twelfth of a "mortgage insurance premium" (to insure the loan).

Since something is paid on the principal each month, the amount of the debt gets steadily less. The rate of interest remains the same, but since the debt decreases, so does the amount of the interest. Thus each month, more of the payment is applied to the principal.

Example

Mr. and Mrs. Hart recently bought a house and lot for \$10,000. They made a down payment of \$4000 and borrowed \$6000 from their bank at $4\frac{1}{2}$ per cent interest per year. They arranged to pay the bank \$45.90 a month. This amount covers interest and payment on the principal (not taxes or insurance) such that the loan will be completely repaid in 15 years.

a. Of the first monthly payment, what part was payment on principal?

b. Of the second monthly payment, what part was payment on principal?

What to Do	How to Do It
(1) Find the interest on the loan for one month.	$P = \$6000$; $r = .045$ $t = \frac{1}{12}$ $I = P \times r \times t$ $I = \$6000 \times .045 \times \frac{1}{12} = \$22.50$
(2) Find the amount of the first payment that applied to the principal.	$\$45.90 - \$22.50 = \$23.40$ Answer
(3) Find the principal during the second month.	$\$6000 - \$23.40 = \$5976.60$
(4) Find the interest for one month on the new principal.	$I = \$5976.60 \times .045 \times \frac{1}{12} = \$22.41$
(5) Find the amount of the second payment that applied to the principal.	$\$45.90 - \$22.41 = \$23.49$ Answer

PROBLEMS

1. Mr. Warner bought a house for \$8000, paying \$4000 in cash and borrowing the remaining \$4000 from a bank. He agreed to pay the bank \$30.60 a month for 15 years. These monthly payments included interest at $4\frac{1}{2}$ per cent per year and payment on the principal.

a. For each of the first two payments, find what part was interest and what part was applied to principal.

b. How much was the principal reduced the first two months?

2. The Smith family decided to buy a lot and build a house on it. They had to borrow \$9000 to complete the payment of the house and lot. They found that a payment of \$56.97 a month would cover the interest charge of $4\frac{1}{2}$ per cent per year and would repay the loan in 20 years.

a. For each of the first two payments, find what part was interest and what part was payment on principal.

b. How much was the principal reduced the first two months?

3. The monthly payment on the principal and interest on a \$6000 FHA loan, to be repaid in 10 years, is \$62.22. The rate of interest on the loan is $4\frac{1}{2}$ per cent and the average monthly mortgage insurance premium is \$1.19.

a. Find the total of the payments on the principal and interest for 10 years.

b. Find the total interest paid on the loan in 10 years.

c. Find the total of the mortgage insurance premiums for 10 years.

4. The monthly payment on the principal and interest on an FHA loan of \$12,000 to be repaid in 15 years is \$91.80. The average monthly mortgage insurance is \$1.39.

a. Find the total of the payments on the principal and interest for 15 years.

b. Find the total amount paid in interest in 15 years.

c. Find the total of the mortgage insurance premiums for 15 years.

5. Mr. and Mrs. Richards bought a house and lot for $8000. They paid $2000 down and obtained an FHA loan for the balance. They agreed to pay off the loan in monthly payments of $54.21 over a period of 20 years. The payments were to include interest ($4\frac{1}{2}\%$ per year) and amortization, taxes, fire insurance premiums, and mortgage insurance at $\frac{1}{2}$ per cent per year. During the first six months, the Richards' monthly payment included $12.50 for taxes, $1.35 for fire insurance, and $2.38 for mortgage insurance.

a. During the six months, how much of each payment went for interest and how much for reducing the principal?

b. At the end of six months, how much did the Richards owe on their property?

Keeping the Interest Cost Low

There are three factors that determine how much money a borrower must pay as interest on his loan. One is the *interest rate.* If he is able to borrow money at $4\frac{1}{2}$ per cent per year, he pays less per year for the same loan than if he borrows at 5 or 6 per cent per year. The second factor is *the size of the loan.* If he is able to make a large down payment on his home, he need borrow less money and thus pay less interest than if he can make only a small down payment. The third factor is *the length of time for which he owes money.* The larger the monthly payments a borrower can make on his loan, the sooner he is out of debt and the less he pays as interest.

Table 20. MONTHLY PAYMENTS REQUIRED TO PAY OFF A LOAN OF $1000 IN TEN TO TWENTY-FIVE YEARS AT 4 TO 6 PER CENT ANNUAL INTEREST

Length of Loan	*Rate of Interest*			
	4%	*$4\frac{1}{2}\%$*	*5%*	*6%*
10 Years	$10.13	$10.37	$10.61	$11.11
15 Years	7.40	7 65	7.91	8.44
20 Years	6.06	6.33	6.60	7.17
25 Years	5.28	5.56	5.85	6.45

Table 20, page 409, shows the monthly payments required to pay off a loan of $1000 at different rates of interest when the loan runs for different periods of time. The payments given in this table do not take account of payments on taxes, insurance on the house, or mortgage insurance; they refer only to interest and amortization.

PROBLEMS

Refer to Table 20, page 409, as you solve these problems.

1. Find the interest that must be paid on a loan of $5000, repaid in 20 years, at 4 per cent annual interest.

2. How much interest must be paid on a loan of $7500, repaid in 15 years, at 5 per cent annual interest?

3. How much money can be saved if a loan of $8000 at 5 per cent annual interest is repaid in 20 years instead of in 25 years?

4. How much might be saved on the cost of a loan of $6000 at $4\frac{1}{2}$ per cent annual interest, if repaid in 15 years rather than in 20 years?

5. A loan of $8000 is to be repaid in 20 years. How much less is the interest cost at 4 per cent than at 6 per cent?

6. Mr. Ellis and Mr. Johnson both have loans of $6000, to be repaid in 20 years, on their homes. Mr. Ellis pays $4\frac{1}{2}$ per cent interest and Mr. Johnson pays 5 per cent. Find the difference in the total amount of interest on the two loans.

7. To complete the payment on a house and lot, Mr. Miner borrowed $5000 at $4\frac{1}{2}$ per cent interest. How much less interest would he have to pay on the loan if he repaid it in 10 years rather than in 15 years?

8. Mr. and Mrs. Wheeler obtained a loan of $6000 to be repaid in 25 years. The interest rate was $4\frac{1}{2}$ per cent. How much more will they pay in interest than they would if they had decided to repay the loan in 15 years?

9. Mr. Robbins is planning to build a house at a cost of $12,500 on a lot that cost $2500. He can obtain a 20-year loan at 5 per cent interest, if he makes a down payment of

20 per cent of the cost of the house and lot. If he pays 40 per cent in cash, he can obtain a 20-year loan at 4 per cent interest.

a. Find the amount of the loan, if he pays 20 per cent in cash.

b. Find the amount of each monthly payment on the 5 per cent loan.

c. Find the total amount of interest he would have to pay on the 5 per cent loan.

d. What would be the amount of the loan, if he paid 40 per cent in cash?

e. Find the amount of each monthly payment on the 4 per cent loan.

f. Find the total amount of interest he would have to pay on the 4 per cent loan.

10. Mr. Adams wants to buy a house for $12,500, to be completely paid for fifteen years from now. He can get an FHA loan for 80 per cent of the cost at $4\frac{1}{2}$ per cent interest, or a regular bank loan for 60 per cent of the cost at 4 per cent interest.

a. How much cash would he need to obtain the loan at 4 per cent interest?

b. How much would he have to pay monthly on the 4 per cent loan?

c. How much interest would he have to pay on the 4 per cent loan?

d. What down payment would he have to make on the $4\frac{1}{2}$ per cent loan?

e. How much would he have to pay each month for interest and amortization of the $4\frac{1}{2}$ per cent loan?

f. Find the total amount of interest on the loan at $4\frac{1}{2}$ per cent.

Table 20, page 409, shows the monthly payments required to pay off a loan of $1000 at different rates of interest when the loan runs for different periods of time. The payments given in this table do not take account of payments on taxes, insurance on the house, or mortgage insurance; they refer only to interest and amortization.

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4. How much might be saved on the cost of a loan of $6000 at $4\frac{1}{2}$ per cent annual interest, if repaid in 15 years rather than in 20 years?

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6. Mr. Ellis and Mr. Johnson both have loans of $6000, to be repaid in 20 years, on their homes. Mr. Ellis pays $4\frac{1}{2}$ per cent interest and Mr. Johnson pays 5 per cent. Find the difference in the total amount of interest on the two loans.

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a. Find the amount of the loan, if he pays 20 per cent in cash.

b. Find the amount of each monthly payment on the 5 per cent loan.

c. Find the total amount of interest he would have to pay on the 5 per cent loan.

d. What would be the amount of the loan, if he paid 40 per cent in cash?

e. Find the amount of each monthly payment on the 4 per cent loan.

f. Find the total amount of interest he would have to pay on the 4 per cent loan.

10. Mr. Adams wants to buy a house for $12,500, to be completely paid for fifteen years from now. He can get an FHA loan for 80 per cent of the cost at $4\frac{1}{2}$ per cent interest, or a regular bank loan for 60 per cent of the cost at 4 per cent interest.

a. How much cash would he need to obtain the loan at 4 per cent interest?

b. How much would he have to pay monthly on the 4 per cent loan?

c. How much interest would he have to pay on the 4 per cent loan?

d. What down payment would he have to make on the $4\frac{1}{2}$ per cent loan?

e. How much would he have to pay each month for interest and amortization of the $4\frac{1}{2}$ per cent loan?

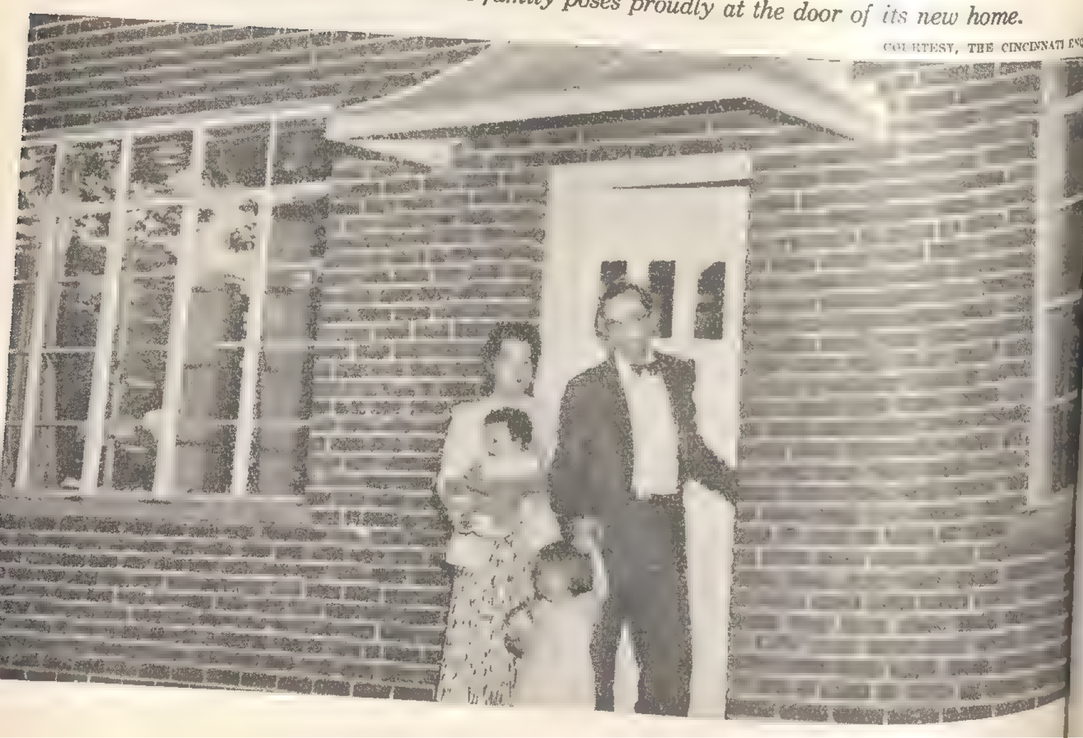
f. Find the total amount of interest on the loan at $4\frac{1}{2}$ per cent.

What You Have Learned in This Chapter

1. To compare the costs of owning and renting a home
2. To calculate taxes on real estate from the tax rate and the assessed valuation
3. To decide how much a person can afford to pay for a house ($2\frac{1}{2}$ times the annual income)
4. To decide how much a person can afford to spend monthly on a place to live (25 per cent of the monthly income)
5. To find the amount needed for a down payment on a house
6. To determine how much of each monthly payment on a house is applied to the principal of the loan
7. To compare the cost of buying a house when down payments are for different amounts, when the loan is made at different rates, and when the loan is paid off over different periods of time
8. To use and understand the terms: *depreciation, assessed valuation, tax rate, amortization*

This family poses proudly at the door of its new home.

COURTESY, THE CINCINNATI ENQUIRER



Review Test on Owning Your Home

1. The Armstrongs pay \$80 a month rent for a house valued at \$10,000. If the owner of the house were to sell it, he could invest the money he receives at 3 per cent interest. The tax bill on the property averages \$165.80 annually. Fire insurance on the house costs \$12.50 a year. An average of \$225 is spent on upkeep, and the depreciation amounts to \$200 a year. Which is more, and how much more, the annual rent paid by the Armstrongs or the annual cost of owning the home?

2. Mr. Zimmerman's new house cost him \$12,500. It is assessed at 55 per cent of the purchase price. The tax rate this year is \$26.80 per \$1000. How much must Mr. Zimmerman pay in taxes on his house?

3. Mr. Bryant has an income of \$3600 a year.

a. What is the most you think he should pay for a house and lot?

b. Can he afford a monthly payment of \$90 for interest and amortization? Explain your answer.

4. Mr. and Mrs. Allen borrowed \$8000 from a bank to complete the payment on a house and lot. The rate of interest was $4\frac{1}{2}$ per cent. They arranged to pay the bank \$61.20 monthly.

a. How much of the first monthly payment was applied to the principal?

b. How much of the second monthly payment was payment on principal?

5. The monthly payment on the principal and interest on a 20-year loan of \$1000 at $4\frac{1}{2}$ per cent is \$6.33. The monthly payment on a 20-year loan of \$1000 at 5 per cent is \$6.60. Find the amount that might be saved by obtaining a 20-year loan of \$6000 at $4\frac{1}{2}$ per cent interest rather than at 5 per cent.

How do you rate?	Excellent	Good	Fair	Poor
	5	4	3	2 or less

CHAPTER 12

GALLOWAY

1. Plan a trip by automobile, estimating all expenses as closely as you can.
2. Find out current prices of new cars delivered to the purchaser, and the trade-in values of used cars of different years and makes. Ask an automobile dealer what per cent of his customers pay cash and what per cent finance their cars.
3. Collect the facts about serious automobile accidents within a radius of five or ten miles of your home. What seemed to be the cause of each accident?
4. Select some distant point you would like to visit, and plan a trip to it. Find out how you could get there by bus, by train, and by airplane. Find out the fares by each method of transportation and the time each takes. Estimate the total cost of your trip.

GOING PLACES

No matter where you live, there are times when you want to go away from home — to travel by automobile or by bus, train, or airplane. You will want to be able to plan trips and to select the kinds of transportation that serve your purposes best.

The Cost of an Automobile

The most common method of traveling in America is by automobile. There is one automobile for every four or five persons — a total of over thirty million cars. These cars travel over a vast network of highways that are built and maintained by local, state, and Federal funds.

For many families, the cost of owning and operating the family car is one of the large items of expense in their budget, exceeded only by the cost of food, shelter, and clothing.

Running Expenses

One type of expense which is incurred in owning an automobile depends almost entirely upon the number of miles the car is driven. Included in this type of expense are the cost of gasoline, grease and oil, tires, repairs, and miscellaneous expenses. These *running expenses* vary considerably with different cars driven under different conditions. Table 21, page 416, shows the average cost per mile for the running expenses of an inexpensive automobile.

Table 21. AVERAGE RUNNING COSTS PER MILE OF A LOW-PRICED AUTOMOBILE

Gasoline	$.0126
Oil and grease	.0026
Tires	.0023
Repairs and miscellaneous expenses	.0056

PROBLEMS

Refer to Table 21 as necessary in solving these problems.

1. Arthur Williams and Henry Taylor plan to take a vacation trip of about 1500 miles in Arthur's automobile. Henry has agreed to pay for the gasoline, oil, and grease. About how much will Henry have to pay for the trip?

2. Mr. Jensen recently kept a record of what he spent on his automobile in a year during which he drove 12,000 miles. His record follows:

Gasoline	$152.90
Grease	6.25
Oil	15.75
Tires and tubes	25.25
Repairs	123.60

a. Find the total of the running expenses.
b. Find Mr. Jensen's running costs per mile.

3. Mr. Motley kept a record of his expenditures on his car for one year, during which he drove 24,000 miles. His record included:

Gasoline, oil, and grease	$364.80
Repairs	108.00
Tires and tubes	67.20

a. Find the total of the running expenses for the year.
b. Find Mr. Motley's running expenses per mile.

4. George Mueller is the travel editor for a midwestern newspaper. To get information for his articles, he and Mrs. Mueller took a vacation trip by automobile through the middle west and the mountain states. They spent 28 days

on their trip and traveled 6800 miles in 18 states. In figuring the cost of their trip, the Muellers did not include fixed expenses on their car. Their record follows:

Gasoline	$106.69
Oil and greasing	11.58
Car wash	2.50
Repairs	17.13
Food	132.95
Lodging	114.20
Tolls and other fees	13.20

a. What was the average cost of food per day for each person?

b. What was the average cost per night for lodging for each person?

c. What was the average cost per day for transportation?

d. Find the cost per mile of transportation.

e. Find the total expenses of the trip.

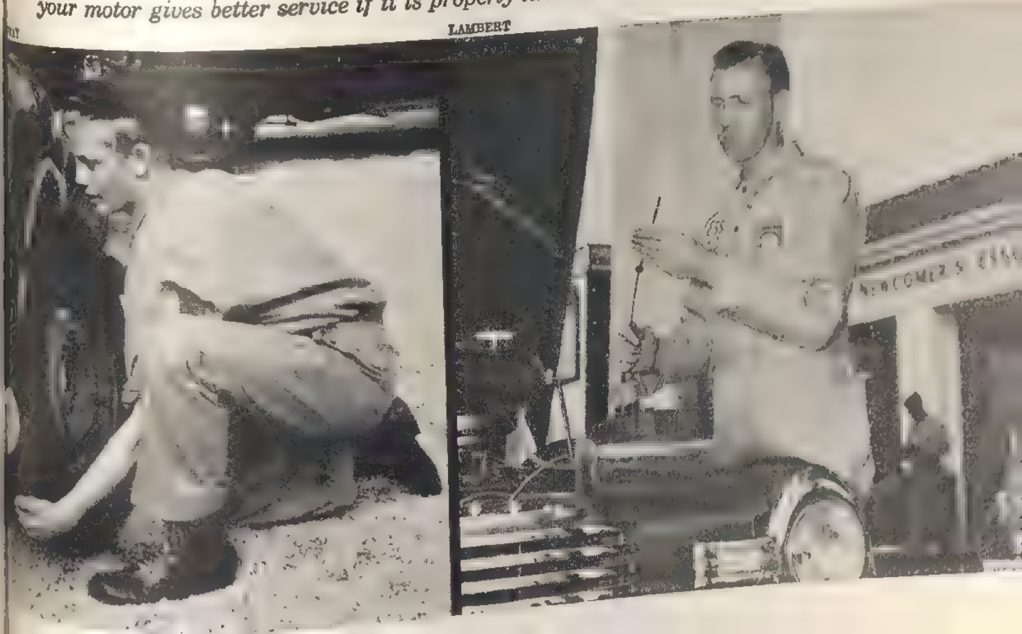
f. Find the average cost of the trip per day for each person.

g. Find the average daily mileage.

5. Evelyn Atkinson's father lent her his car for a trip with three friends. The tour lasted eleven days and covered 2738 miles. One of the four girls acted as bookkeeper, and at the end of the trip made the following report of expenses:

Two ways of reducing running expenses are suggested by these pictures. You get better service from your tires if you occasionally move them from wheel to wheel. And your motor gives better service if it is properly lubricated.

LAMBERT



Gasoline	$ 32.52
Oil	6.30
Grease	1.25
Fixing flat tire	1.50
Parking fees	2.75
Tolls	2.20
Rooms	98.00
Meals	121.63

a. What was the average cost per day of food for each girl?

b. What was the average cost per day of lodging for each girl?

c. What was the average cost per day of transportation?

d. Find the cost per mile of transportation.

e. Find the total expenses of the trip.

f. If the girls shared expenses equally, how much did each pay?

g. Find the average daily mileage.

Fixed Expenses

In addition to the running expenses, the car owner must consider *fixed expenses* such as depreciation, automobile insurance, registration fee, garage rent, and local taxes. These expenses have to be paid whether the car is driven or not. Of course, they vary from place to place.

PROBLEMS

1. Ellen Livingston must pay $10 a month for her garage. The insurance on her car costs her $62.40 per year, and registration fees come to $7.00 annually. She figures the depreciation on the car as $250 per year. What amount should she budget monthly for the fixed expenses on her car?

2. Last year Mr. Snyder had the following fixed expenses on his car:

Depreciation	$225.00
License and registration	14.90
Garage	48.00
Insurance	46.50

What do his total fixed expenses average per mile:

a. If he drives 6000 miles per year?
b. If he drives 12,000 miles per year?
c. If he drives 24,000 miles per year?

3. Mr. Turner's fixed expenses on his automobile are as follows:

Insurance	$ 61.56
Registration fee	21.25
Garage rent	60.00
Depreciation	250.00

What do his total fixed expenses average per mile:

a. If he drives 9000 miles per year?
b. If he drives 15,000 miles per year?
c. If he drives 21,000 miles per year?

4. A year ago, Mr. Warner bought a car for $1425. He has now driven the car 12,000 miles, and values it at $1140. His tires, costing $14.75 each, are supposed to be good for about 30,000 miles. A record of his expenses for the year follows:

Gasoline	$177.45
Oil	12.25
Greasing	7.50
Repairs	14.85
Wear on tires	23.60
Antifreeze	2.40
Driver's license	.40
Registration fee	10.25
Automobile insurance	52.40
Garage rent	48.00

a. What were Mr. Warner's fixed expenses?
b. How much did his running expenses amount to?
c. Find the total cost per month of owning and operating this car.

5. Two years ago last July, Mr. Jones bought a used car for $915 cash. This past July, he received an allowance of $595 for the car on a trade-in for a new one. The record of his expenses during the two years he drove the car included:

Repairs, upkeep, and accessories . . .	$140
Tires	40
Insurance, licenses, etc.	135
Gasoline	260
Oil and grease	35
Garage rent	125

a. What were Mr. Jones's fixed expenses per year?

b. What were his running expenses per year?

c. Find the total cost per month of owning and operating this car.

Gasoline Taxes

All the states have gasoline taxes. These range from 2 cents per gallon to 7.5 cents per gallon. You pay a gasoline tax every time you buy gasoline; the price per gallon includes the tax.

The money you pay in gasoline taxes and other fees — and fines, if you are careless — is used by the state to pay for building new roads, for repairing roads already built, for maintaining the highway police, and for administering the state motor vehicle department. These expenses are made necessary in large part by automobiles; they are met by the people who own and drive cars.

PROBLEMS

1. The gasoline tax in Delaware was 4 cents a gallon in a year when drivers bought 64,615,000 gallons of gasoline. How much revenue did the state receive from the gasoline tax?

2. Georgia's gasoline tax was 6 cents per gallon in a year in which automobile operators bought 475,202,000 gallons of gasoline. How much did Georgia receive from the gasoline tax?

3. One year Alabama collected $22,811,000 in taxes and fees from automobile drivers. The tax per gallon of gasoline was 6 cents, and 364,153,000 gallons were used. How much money did Alabama collect from automobile drivers in fees and taxes other than those on gasoline?

4. One year Arizona collected 5 cents per gallon on 154,948,000 gallons of gasoline bought by automobile drivers. The total amount collected that year in automobile taxes and fees, including gasoline taxes, was $8,510,000. How much revenue did Arizona receive from automobile taxes and fees, not including gasoline taxes?

5. One year 427,597 motor vehicles were registered in Louisiana. They consumed 347,953,000 gallons of gasoline. The tax per gallon was 7 cents.

a. What was the average amount of gasoline per motor vehicle?

b. How much was the revenue from gasoline tax per motor vehicle?

6. In Maine one year, there were 232,760 motor vehicles registered; they used 173,001,000 gallons of gasoline. The state gasoline tax was 4 cents per gallon.

a. On the average, how much gasoline did each motor vehicle use?

b. On the average, how much revenue from gasoline tax did each motor vehicle account for?

7. Mrs. White's car averaged 20.3 miles per gallon of gasoline. One year she drove it entirely in her own state, where the tax was $.03 per gallon. Her total mileage that year was 11,165 miles. How much did she pay in gasoline taxes?

8. Mr. Carstairs gets 17.5 miles per gallon of gasoline in driving his car. In a year in which he bought gasoline only in his own state and the one

Gasoline taxes are an important part of government income. You have probably often noticed the way in which gasoline prices are posted at service stations.

FREDERIC LEWIS

LAMBERT

If you can manage to pay cash for your automobile, you save a substantial sum in interest.

adjacent to it, he drove 14,175 miles. Both states had gasoline taxes of \$.04 per gallon. How much did gasoline taxes cost Mr. Carstairs that year?

9. In a recent year, the state of Maryland received \$15,462,000 from motor vehicle fees and taxes, including gasoline taxes. That year Maryland spent \$3,260,000 in building roads and highway bridges, \$2,725,000 in maintaining highways already built, and \$4,237,000 for administration, highway police, and similar expenses connected with the state highways. What per cent of the income from motor vehicle taxes and fees was used for each kind of expense?

10. In a recent year, the state of Mississippi received \$14,579,000 from motor vehicle fees and taxes, including gasoline taxes. Of this amount, \$1,771,000 went for construction of new roads and bridges, \$1,926,000 for maintenance of existing roads, and \$6,552,000 for other expenses connected with the state highway system. What per cent of the income from fees was used for each class of expense?

When You Buy an Automobile

Most people who buy automobiles do so by making a down payment equal to one third of the cash price and paying the balance due plus a carrying charge in equal monthly installments. Automobile dealers often encourage purchasers to use this plan. Many buyers, however, prefer to pay cash. They say that an automobile is so expensive, both in purchase price and operating cost, that they cannot afford to pay interest charges as well. As you know, interest rates on installment purchases are much higher than they appear. (See Chapter 5, pages 213–216.)

When an automobile is bought on the installment plan, the finance (loan) company that handles the purchase requires that the buyer take out insurance on his car. Usually the finance company arranges for the insurance, and its cost is added in with the total cost of the car.

Example The total price of Mr. Mason's new car was \$2277. He made a down payment of one third the price and arranged to pay 15 monthly installments of \$108 each. What rate of interest did Mr. Mason pay?

What to Do	How to Do It
(1) Find the balance due.	$\frac{1}{3} \times \$2277 = \$759$ $\$2277 - \$759 = \$1518$
(2) Determine what amount of each payment may be considered payment on principal.	$\$1518 \div 15 = \$101.20$
(3) Find the average debt.	$\$1518 + \$101.20 = \$1619.20$ $\$1619.20 \div 2 = \$809.60$
(4) Find the amount of interest.	$\$108 - \$101.20 = \$6.80$ $15 \times \$6.80 = \$102$
(5) Divide the amount of interest by the product of the average debt and the time in years; express the result as a per cent.	$\frac{15}{12} \times \$809.60 = \$1012.00$ $\$102 \div \$1012 = .1007$ $.1007 = 10.1\%$ Answer

PROBLEMS

Most of these problems are slightly different from the example above; so be sure to read each problem carefully.

1. After making his down payment, Mr. Weber owed \$1610.27 on his new car. He agreed to make 12 monthly payments of \$144 each. Find the rate of interest.

2. John Baker would like to trade in his old automobile on a new one that sells for \$2425 plus 2 per cent sales tax. The dealer has offered Mr. Baker \$385 for his old car. The down payment, including the trade-in value of the old car, must be one third of the total cost of the new car plus one third of the insurance charge of \$49.50. The balance is to be paid in 12 monthly installments of \$148 each.

a. What rate of interest would Mr. Baker have to pay?

b. How much cash must he have to complete the down payment?

3. Mr. Wyant bought an automobile with a cash price of \$1500. The sales tax was $2\frac{1}{2}$ per cent; the insurance was \$28.10; and other fees were \$3.40. He made a down payment of one third of these amounts. The carrying charge was 6 per cent of the balance due. Mr. Wyant made 12 monthly payments to complete the purchase of the car.

a. How much was each installment?

b. What rate of interest did Mr. Wyant pay?

4. The automobile George Anderson wanted was priced at \$1750 plus 2 per cent sales tax. Mr. Anderson wished to pay for the car in 15 equal monthly payments. The dealer told him that after the sales tax and an insurance charge of \$61.98 were added to the price, a down payment of one third of the total would be required, and that the monthly installment would be \$88.96. An allowance of \$365 made for Mr. Anderson's old car could be applied to the down payment.

a. How much cash would Mr. Anderson need in order to purchase this automobile?

b. What carrying charge would he have to pay?

c. What rate of interest would he have to pay?

5. Mr. Otis was considering buying an automobile priced at \$2240. (There is no sales tax in his state.) The dealer told him that insurance would amount to \$52, and that he could pay for the car and the insurance by making a down payment of one third the total cash price and 12 monthly payments of \$135. Mr. Otis decided to withdraw \$2292 from the bank and pay cash for his car and the insurance on it.

a. How much less did Mr. Otis pay than he would have spent had he bought the car on time?

b. How much did Mr. Otis lose in interest at 2 per cent compounded semiannually by withdrawing the entire price of the car instead of only enough for the down payment?

c. How much did he save by paying cash?

Automobiles and Safety

Most of you will drive a car some day, if you don't already. You should know what actions of drivers result in accidents

"Let's turn toward home. My mother's probably worrying about me — and so am I."

so that you can avoid such actions. It is a sad fact that young drivers have more accidents than older drivers. Although only 14.4 per cent of the licensed drivers in one state were under 25 years of age, these young drivers had 28.5 per cent of all the fatal accidents and 23.8 per cent of all the non-fatal accidents. This fact does not mean that young people are incapable of driving a car well. They are just as capable as older persons — probably more capable. But they are likely to take chances and to drive too fast.

Speed and Automobile Accidents

The most important rule to remember in order to avoid automobile accidents is this: Keep your speed down. There are two chief reasons why this rule is so important: (1) The faster a car is traveling, the longer the time required to stop it. (2) The faster a car is going, the harder it hits any object with which it collides.

You usually speak of the speed of an automobile in miles per hour. However, you can stop a car in a matter of seconds, and during this time it goes a certain number of feet. Therefore it is convenient to consider speeds in feet per second. A car going 30 miles an hour travels 44 feet each second.

Example What is the speed in feet per second of an automobile going 30 miles per hour?

What to Do	How to Do It
(1) Determine how many feet the car will travel in 1 hour.	5280 feet = 1 mile 30 × 5280 = 158,400 feet
(2) Compute the number of seconds in 1 hour.	60 seconds = 1 minute 60 minutes = 1 hour 60 × 60 = 3600 seconds
(3) Find how many feet the car will travel in 1 second.	158,400 ÷ 3600 = 44 30 mi. per hr. = 44 ft. per sec. Answer

Suppose you are driving at 30 miles per hour on a dry road that is level and has a good surface. The tires of your car are in good condition and properly inflated. Your car has good brakes. If you are a good driver, you can bring your car to a stop in a little less than 2 seconds.

The time it takes you to stop your car is made up of two parts: (1) your *reaction time*, and (2) the time required for the brakes to bring the car to rest.

Reaction time is the time it takes for the driver to see danger in the road ahead of him, to move his foot to the brake pedal, and to apply the brakes. For most persons, this time is about three fourths of a second. Figure 12–1 shows average distances required to stop a modern car at various speeds with good brakes and tires on a dry, level, well-paved road.

PROBLEMS

Refer to Figure 12–1, pages 428–429, while solving these problems.

1. If a driver's reaction time is .7 of a second, how many feet will his car travel between the time he sees danger in the road ahead of him and the time he actually exerts pressure on the brake pedal at the following speeds: (*Hint:* Express each speed in feet per second.)

a. 20 mi. per hr. **b.** 40 mi. per hr. **c.** 60 mi. per hr.

2. If a driver's reaction time is .8 of a second, how many feet will his car travel between the time he decides to stop and the time he actually exerts pressure on the brake pedal at the following speeds: (*Hint:* Change each speed to feet per second.)

a. 30 mi. per hr. **b.** 50 mi. per hr. **c.** 60 mi. per hr.

3. If an automobile with good brakes is traveling at 50 miles per hour along a good pavement, what is:

a. The distance traveled during the driver's reaction time?
b. The braking distance?
c. The total distance traveled after danger has been seen?

3. In what per cent of the total number of deaths caused by drivers' errors was the cause "reckless driving"?

4. In what per cent of the total number of deaths caused by drivers' errors were the drivers speeding?

5. In what per cent of the total number of deaths caused by drivers' errors were the drivers passing improperly? Include "cutting in" as improper passing.

Table 22. DEATHS AND INJURIES RESULTING FROM IMPROPER ACTIONS OF AUTOMOBILE DRIVERS IN A SINGLE YEAR

Action of Driver	*Deaths*	*Injuries*
Exceeding speed limit	9,460	230,760
On wrong side of road	3,410	120,060
Did not have right of way	2,970	194,140
Cutting in	270	25,550
Passing standing street car	20	1,700
Passing on curve or hill	80	2,550
Passing on wrong side	450	14,480
Failing to signal and improper signaling	530	71,530
Car ran away — no driver	40	1,700
Drove off roadway	1,120	22,140
Reckless driving	3,500	148,160
Miscellaneous	450	18,730
TOTAL	22,300	851,500

Public Transportation

Every year millions of Americans travel to distant parts of this country, Canada, and Mexico by train, bus, or airplane. To plan their trips, they must know something of the services offered by each form of transportation and be able to interpret time tables. They should also have an idea of the fares charged by the transportation companies. When travelers go over long distances, they have to take differences in time into account.

Time Zones

Continental United States is divided into four time zones, as shown in Figure 12–2, page 432. Standard time in the eastern zone is one hour later than standard time in the central zone, two hours later than standard time in the mountain zone, and three hours later than standard time in the Pacific zone. In traveling to the West across the continent, people set their watches back one hour when they go from one time zone into another; in traveling to the East, they move their watches forward. Daylight saving time is one hour faster than standard time. Since daylight time is a local matter, transportation companies usually operate on standard time.

Example

A bus that left San Francisco, California, at 7:30 A.M. Pacific Standard Time arrived at Phoenix, Arizona, at 11:45 P.M. Mountain Standard Time. How long was it on the road?

What to Do	How to Do It
(1) Express the time of starting in terms of the time zone in which the trip ended.	7 : 30 A.M. PST = 8 : 30 A.M. MST
(2) Find the length of time between the starting time and noon.	8 : 30 A.M. to 12 NOON = 3 hr. 30 min.
(3) Find the length of time between noon and the time the trip ended.	12 NOON to 11 : 45 P.M. = 11 hr. 45 min.
(4) Find the total time on the road.	3 hr. 30 min. + 11 hr. 45 min. 14 hr. 75 min. 75 min. = 1 hr. 15 min. 14 hr. 75 min. = 15 hr. 15 min. Answer

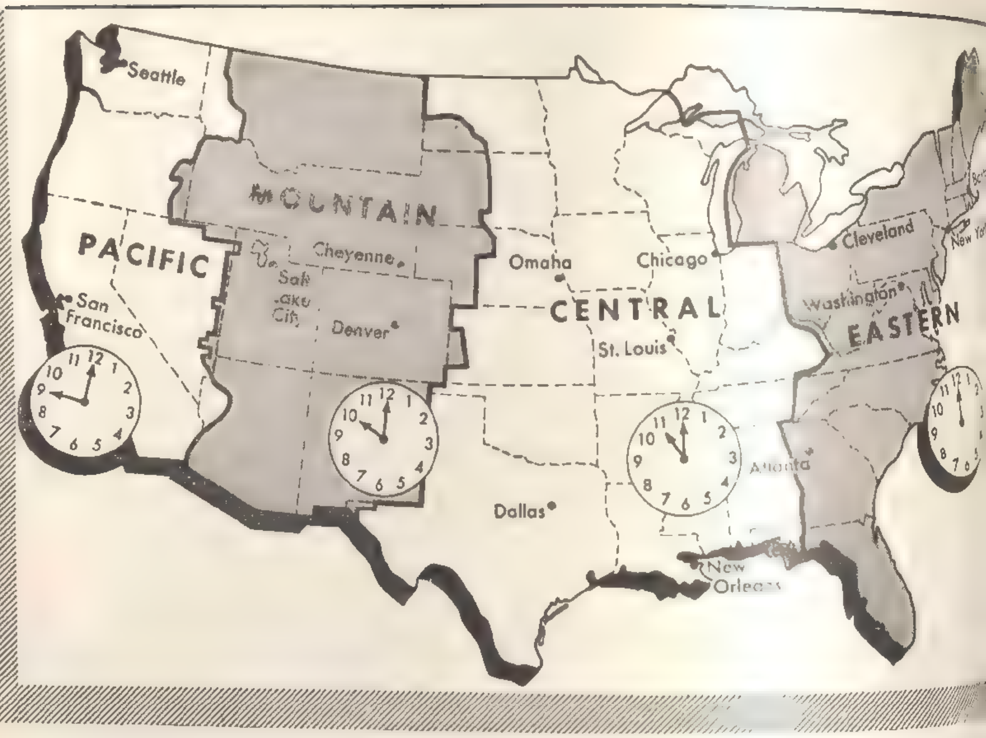


Figure 12-2

PROBLEMS

Refer to Figure 12–2 in solving these problems.

1. A nation-wide radio program originates in New York at 7:30 P.M. Standard Time. At what time is this program scheduled in Oregon?

2. The President of the United States addressed the Congress at noon Standard Time. What time was his speech heard in San Francisco?

3. A bus which left Columbus, Ohio, at 8:25 A.M. Eastern Standard Time arrived at Indianapolis, Indiana, at 1:30 P.M. Central Standard Time. How long was it on the road?

4. A train which leaves Chicago at 2:00 P.M. Central Standard Time on Monday arrives in Denver at 8:30 A.M. Mountain Standard Time on Tuesday. How many hours does the trip take?

5. Mr. Hames flew from New York to Portland, Oregon, in 16 hours. He left New York at 2:00 A.M. At what time did he reach Portland?

6. A flight leaves Chicago at 4:00 P.M. It takes 8 hours to reach Los Angeles. At what time does it arrive?

7. At 6:30 A.M. a train left a town in the central time zone and after 45 minutes arrived at one in the eastern zone. At what time did it arrive?

8. A telegram sent from Philadelphia at 5:45 P.M. Eastern Daylight Saving Time was delivered in Los Angeles at 2:15 P.M. Pacific Standard Time. How long did it take?

9. A train leaving Seattle at 8:00 P.M. Standard Time Saturday takes 70 hours to reach Chicago, which is on daylight saving time. On what day and at what hour does it arrive?

10. A train leaves Salt Lake City at 7:00 A.M. Standard Time on Monday. It takes 53 hours to reach New York. If New York is on daylight saving time, what hour of what day does a passenger on the train arrive?

Reading Timetables

Timetables for trains, buses, and airplanes are all much alike. They tell the times of arrival at various places and times of departure. They may also give the mileage between cities and the fares; and generally they include a map showing the route traveled.

Figure 12–3, page 434 shows the trains that run between St. Louis and Cincinnati on one railroad. The stations on the way are listed in the center column. The abbreviations *Lv* and *Ar* stand for *leave* and *arrive*. The distance of each station from St. Louis is given in the column headed "Miles."

The table shows that there are four trains on this line that go from St. Louis to Cincinnati, and four trains that go from Cincinnati to St. Louis. The train numbers are given at the heads of the columns. In reading the columns to the left of the list of stations, you read *down* the columns; in reading those to the right, you read *up*. The figures in these columns

show when the trains stop at the various stations. Heavy figures show P.M. time; light figures show A.M. time.

Sometimes symbols appear in a column as well as figures. The meaning of these symbols is explained in a list of reference marks in the timetable.

Figure 12–3

St. Louis and Cincinnati

446-410 Daily	434-410 Daily	24-406 Daily	12-416 Daily	Miles	Table No. 20	415-111 Daily	405-407 Daily	443-431 Daily	437-427 Daily
PM	PM	■	AM			PM	PM	AM	AM
11 32	9 30	1 00	9 10	0.0	Lv St.Louis (Un.Sta.) (C.T.) Ar	3 45	10 45	7 10	7 25
					Lv Washington Avenue... Lv			6 59	7 14
				9.0	Lv Granite City.......... Lv			6 35	
				11.6	Lv Nameoki.......... Lv				
				14.1	Lv Mitchell.......... Lv				
	10 20			37.4	Lv Livingston.......... Lv			▲ 5 51	
	10 46			58.0	Lv Hillsboro.......... Lv			5 24	
				62.9	Lv Irving.......... Lv				
				67.4	Lv Witt.......... Lv				
	11 03			72.2	Lv Nokomis.......... Lv			▲ 5 00	
				76.8	Lv Ohlman.......... Lv				
				80.8	Lv Rosamond.......... Lv				
	11 27			85.2	Lv Pana.......... Lv		∅ 8 58	4 43	∅ 5 32
				91.6	Lv Tower Hill.......... Lv				
	11 44			100.9	Lv Shelbyville, Ill.......... Lv				♣ 5 15
				105.2	Lv Middlesworth.......... Lv				
	11 58			111.8	Lv Windsor.......... Lv			▲ 4 09	
				117.4	Lv Gays.......... Lv				
1 55	12 35	3 05	11 20	124.0	Lv Mattoon.......... Lv		8 15	3 50	4 50
				129.9	Lv Loxa.......... Lv				
	12 51			134.6	Lv Charleston.......... Lv			3 16	
	1 52		ó 11 53	161.5	Lv Paris.......... Lv		7 15	2 31	
				168.2	Lv Vermilion.......... Lv				
				172.3	Lv Sandford.......... Lv				
				176.5	Lv St. Mary of the Woods. Lv				
2 55	2 25	4 00	12 17	180.6	Lv Terre Haute.......... Lv		6 50	2 00	3 40
	3 12		ó 12 45	213.2	Lv Greencastle.......... Lv		6 10	1 15	
				232.9	Lv Danville, Ind.......... Lv				
4 15	4 10	5 13	1 35	252.2	Ar Indianapolis.......... Lv	10 25	5 30	12 30	2 20
4 20	4 20	5 20	1 50	252.2	Lv Indianapolis.......... Ar	10 10	4 30	12 05	1 45
				258.1	Lv Beech Grove.......... Lv				
				265.2	Lv Acton.......... Lv				
		5 58	2 25	279.0	Lv Shelbyville, Ind.......... Lv	9 33	3 52	11 14	£ 1 01
				289.1	Lv St. Paul.......... Lv				
5 26	5 26	6 26	2 53	299.0	Lv Greensburg.......... Lv	9 13	3 32	10 48	12 30
		% 6 45	3 13	314.0	Lv Batesville.......... Lv	s 8 54	3 13	10 20	
				321.9	Lv Sunman.......... Lv				
% 6 16	% 6 15	% 7 15	3 42	339.5	Lv Lawrenceburg Jct. (C.T.) Lv			⊕ 9 41	
7 50	7 50	8 55	5 15	361.1	Ar Cincinnati.....(E.T.) Lv (Union Terminal)	9 00	3 20	10 10	11 55
AM	AM	PM	PM			AM	PM	PM	PM

s Stops Sundays only.

ó Stops on signal to discharge revenue passengers from St. Louis and beyond and to receive revenue passengers for Indianapolis and beyond.

⊕ Stops on signal Sundays only to receive revenue passengers.

∅ Stops on signal discharge revenue passengers from Indianapolis and beyond or to receive revenue passengers for St, Louis

▲ Stops on signal at Windsor on Sundays only to receive or discharge revenue passengers; at Nokomis to receive revenue passengers for St. Louis; at Livingston to receive or discharge revenue passengers.

♣ Stops on signal at Shelbyville, Ill., to discharge revenue passengers from Cleveland or Cincinnati and beyond and to receive revenue passengers for St. Louis.

£ Stops on signal at Shelbyville, Ind., to discharge revenue passengers from points south of Cincinnati

■ Stops on signal at Lawrenceburg Jct. to receive revenue passengers

% Stops on signal week-days at Batesville to discharge revenue passengers from Indianapolis and beyond and receive revenue passengers for Cincinnati and beyond, on Sundays stops regularly: at Lawrenceburg Jct. to discharge revenue passengers from Indianapolis and beyond.

Here is the information the table gives you about train number 446–410. The train runs daily, leaving Union Station, St. Louis, at 11:32 P.M. Central Time. Its first station stop is Mattoon. It leaves Mattoon at 1:55 A.M., stopping next at Terre Haute. It leaves Terre Haute at 2:55 A.M., and arrives in Indianapolis at 4:15 A.M. It remains in Indianapolis for five minutes, leaving at 4:20 A.M. The next stop is Greensburg. The train leaves Greensburg at 5:26 A.M. If a passenger who boarded the train at Indianapolis or before wants to get off at Lawrenceburg Junction, the train will stop there at 6:15 A.M. (Central Time); this fact is shown by the % symbol. Otherwise it will go on directly to Cincinnati. It is due in Cincinnati at 7:50 A.M. Eastern Time.

A traveler between St. Louis and Cincinnati is not limited to train transportation. If he prefers, he may go by bus. Figure 12–4, page 436, shows bus schedules between these cities.

PROBLEMS

1. Referring to Figure 12–3, answer these questions:

a. How long does it take train 12–416 to go from St. Louis, Missouri, to Cincinnati, Ohio?

b. What is the distance by train from Indianapolis, Indiana, to Cincinnati, Ohio?

c. At what times can you get a train from Terre Haute, Indiana, to St. Louis, Missouri?

d. If you wish to travel during your usual waking hours, which trains can you take from St. Louis to Cincinnati?

e. Which of the four trains makes the fastest trip from Cincinnati to St. Louis?

2. Answer these questions with reference to Figure 12–3:

a. How long does it take train 415–111 to go from Cincinnati, Ohio, to St. Louis, Missouri?

b. What is the distance by train from Mattoon, Illinois, to Indianapolis, Indiana?

c. At what times can you get a train from Terre Haute, Indiana, to Cincinnati, Ohio?

d. If you want to travel during the daytime, what train would you take from Cincinnati to St. Louis?

e. Which of the four trains makes the fastest trip from St. Louis to Cincinnati?

3. Answer these questions with reference to Figure 12–4:

a. How long does it take the bus leaving Cincinnati, Ohio, at 4 P.M. to reach St. Louis, Missouri?

b. At what times can you get a bus from Shoals, Indiana, to Cincinnati, Ohio?

c. Which bus makes the fastest time from St. Louis to Cincinnati?

d. If you wanted to go from Cincinnati to St. Louis during daylight, what bus would you take?

4. Answer these questions by referring to Figure 12–4:

a. How long does it take the bus leaving St. Louis, Missouri, at 6 A.M. to reach Cincinnati, Ohio?

b. At what times can you get a bus from Vincennes, Indiana, to St. Louis, Missouri?

c. Which bus makes the fastest time from Cincinnati to St. Louis?

d. If you wanted to go from St. Louis to Cincinnati during daylight, what bus would you take?

5. Herbert Taylor lives in St. Louis. He wishes to attend the opening of a convention Thursday noon in Cincinnati. He has no objection to traveling at night, but he wants to leave home no earlier than necessary. What train or bus would you suggest he take?

Figure 12–4

CINCINNATI—VINCENNES—ST. LOUIS

WESTBOUND READ DOWN — **TABLE No. 70** — **EASTBOUND READ UP**

Daily	Daily	Daily	Daily	Daily	STANDARD TIME		Daily	Daily	Daily	Daily	Daily
AM	AM	PM	PM	PM			PM	PM	AM	AM	AM
2.00	7 00	12 30	4 00	8 15	Lv Cincinnati (E.T.).....▲..Ohio	Ar	5.30	10.15	12.45	7.20	11.40
1.50	6.50	12.20	3 53	8.05	Lv Lawrenceburg (C.T.).▲..Ind.	Lv	3.36	8.15	10.55	5.20	9.39
#5.30	#10.15	#4.00	L7 30	#11.35	Ar Shoals..............▲.. "	Lv	12.15	4.30	7.35	1.40	6.00
5.50	10.30	4.20	8 00	11.55	Lv Shoals..............▲.. "	Ar	L11.41	#4 20	L7.05	11.58	4.13
7.08	11.43	5.33	9.14	1.08	Lv Vincennes...........▲.. "	Lv	10.33	3.07	5 52	11.43	3.58
12.20	4 50	10 45	1 35	6 05	Ar St. Louis⑯ (C.T.)...▲..Mo.	Lv	6.00	10.00	1.00	7.15	11.30
PM	PM	PM	AM	AM			AM	AM	PM	PM	PM

References

L—Meal Stop. #—Rest Stop. ▲—Agencies to which baggage may be checked. AM—Light Face Type. PM—Bold Face Type.

6. George Coombs lives in Cincinnati. He learns on Monday night that he must be in St. Louis by 5 P.M. on Tuesday. What transportation would you suggest that he take?

7. Answer these questions by referring to the air-line timetable that follows:

SPOKANE-PORTLAND

Table 20	172	139	264	116	109
SPOKANE ....(PT)Lv	7 30	......	1 45	4 40	......
WALLA WALLA..........Lv	8 30	......	2 45	5 40	7 20
PENDLETON ....Ar	9 00	...	3 15	6 10	7 50
PENDLETON..........Lv	......	10 15	3 25	......	8 00
THE DALLES..........Lv	......	11 15	—	......	—
PORTLAND ....Ar	......	11 55	4 45	......	9 20

a. If you wished to go from Spokane, Washington, to Portland, Oregon, without changing planes, when would you leave the airport?

b. A business man attended a dinner meeting in Spokane Monday night, and kept a 1 P.M. luncheon appointment in Portland Tuesday. How did he travel from Spokane to Portland?

c. At what times do airplanes go from Pendleton to Portland?

d. A man living in Walla Walla, Washington, flew to The Dalles, Oregon. What arrangements did he make?

8. Refer to the air-line schedule that follows, and answer these questions:

PORTLAND-SPOKANE

Table 24	108	141	185	100	167
PORTLAND ....(PT)Lv	8 00	......	1 15	4 45	......
THE DALLES ....Ar	8 40	......	—	—	......
PENDLETON..........Ar	9 40	...	2 25	5 55	......
PENDLETON Lv	...	10 35	2 35	6 00	9 50
WALLA WALLA..........Ar	...	11 05	3 05	6 30	10 20
SPOKANE. ....Ar	..	12 05	4 05	......	11 20

a. If you wished to fly from Portland, Oregon, to Spokane, Washington, leaving in the morning, how would you be routed?

b. When do flights leave Pendleton for Spokane?

c. A politician addressed an afternoon meeting in Portland and an evening meeting in Pendleton. What flight did he take from Portland to Pendleton?

d. What flight would you take if you wished to go from Portland, Oregon, to Walla Walla, Washington, without changing planes?

9. The condensed railroad schedule below shows the major stops between New York and San Francisco. Answer these questions by referring to it:

Westbound Example READ DOWN		DAILY VIA NEW YORK CENTRAL—NORTHWESTERN—UNION PACIFIC—SOUTHERN PACIFIC				Eastbound Example READ UP	
Fri.	11:00 PM	Lv. New York (Grand Cent. Term.)	NYC	(ET)	Ar.	11:59 AM	Mon.
"	11:48 PM	" Harmon	"	"	"	11:02 AM	"
	....	" Albany	"	"	"	8:55 AM	"
	....	" Schenectady	"	"	"	8:32 AM	"
	....	" Utica	"	"	"	7:14 AM	"
	....	" Syracuse	"	"	"	6:23 AM	"
Sat.	6:50 AM	" Buffalo	"	"	"	3:50 AM	Mon.
"	11:45 AM	" Toledo	"	"	Ar.	11:05 PM	Sun.
"	3:00 PM	Ar. Chicago (La Salle St. Sta.)	"	(CT)	Lv.	6:15 PM	"
"	8:00 PM	Lv. Chicago (C&NW Sta.)	C&NW	"	Ar.	1:00 PM	"
Sun.	5:30 AM	Ar. Omaha, Nebr	"	"	Lv.	3:40 AM	Sun.
"	2:20 PM	" Cheyenne, Wyo	UP	(MT)	"	5:20 PM	Sat.
Mon.	1:03 AM	" Ogden, Utah	"	"	"	6:45 AM	Sat.
"	11:11 AM	" Reno, Nev.	SP	(PT)	"	6:40 PM	Fri.
"	4:10 PM	" Sacramento, Calif.	"	"	"	1:40 PM	"
"	6:12 PM	" Oakland, Calif. (16th St.)	"	"	"	11:38 AM	"
Mon.	6:50 PM	Ar. San Francisco, Calif	"	"	Lv.	11:00 AM	Fri.

a. How many hours does it take to go from New York to San Francisco? (*Hint:* Make allowance for changes in time.)

b. How many hours does it take to go from San Francisco to New York?

c. How much time does a westbound passenger have in Chicago, Illinois?

d. How much time does an eastbound passenger have to spend in Chicago?

e. If you were to leave Buffalo, New York, on Sunday, when would you arrive at Ogden, Utah?

f. If you were traveling from Sacramento, California, to Syracuse, New York, and boarded your train on Monday, when would you reach your destination?

10. The condensed railroad schedule below shows the most important stops between New York and Los Angeles. Answer these questions by referring to it:

Westbound Example READ DOWN		DAILY, EXTRA-FARE SERVICE VIA NEW YORK CENTRAL—SANTA FE				Eastbound Example READ UP	
Fri.	5:00 PM	Lv. New York (Grand Cent. Term.)	NYC	(ET)	Ar.	8:[illegible] AM	Mon.
"	5:46 PM	" Harmon	"	"	"	7:32 AM	"
Sat.	8:00 AM	Ar. Chicago (La Salle St. Sta.)	"	(CT)	Lv.	4:00 PM	Sun.
"	1:30 PM	Lv. Chicago (Dearborn Sta.)	AT&SF	"	Ar.	11:30 AM	"
"	9:50 PM	Ar. Kansas City, Mo.	"	"	Lv.	2:55 AM	Sun.
Sun.	6:25 AM	" La Junta, Colo	"	(MT)	"	4:40 PM	Sat.
"	2:20 PM	" Albuquerque, N. Mex.	"	"	"	8:50 AM	"
"	9:15 PM	" Williams, Ariz.	"	"	"	1:44 AM	"
"	10:05 PM	" Ash Fork, Ariz.	"	"	"	12:42 AM	Sat.
Mon.	4:15 AM	" Barstow, Calif	"	(PT)	"	4:35 PM	Fri.
"	6:30 AM	" San Bernardino, Calif.	"	"	"	2:18 PM	"
"	7:55 AM	" Pasadena, Calif	"	"	"	1:00 PM	"
Mon.	8:30 AM	Ar. Los Angeles, Calif	"	"	Lv.	12:30 PM	Fri.

a. How many hours does it take to go from New York to Los Angeles? (*Hint:* Allow for changes in time.)

b. How many hours does it take to go from Los Angeles to New York?

c. How much time does a westbound passenger have in Chicago, Illinois?

d. How much time does an eastbound passenger have in Chicago?

e. If you were to leave Kansas City, Missouri, on Tuesday, when would you arrive at Albuquerque, New Mexico?

f. If you were to leave San Bernardino, California, on Sunday, when would you reach La Junta, Colorado?

Fares Charged by Transportation Companies

No matter what form of public transportation you use — bus, train, or airplane — the fares you pay depend on the distance you travel. Sometimes fares depend also on the speed with which a trip is made. The fare between two cities on

These girls are behind the scenes at a large railroad station. They make the reservations that passengers ask for at ticket windows. The many-sided board in front of them tells just what space has been assigned on each train.

an express bus may be greater than the fare on a bus that makes many intermediate stops. Some especially fast trains are "extra-fare" trains. An extra fare may be charged for certain very rapid flights.

Railroad fares also vary with the kind of car in which you travel. The fare per mile is always less if you travel in a coach than if you travel in a Pullman car. In a Pullman car, too, there is an extra charge for the space (seat or sleeping accommodation) that is assigned to you. Some railroads carry tourist cars. In these the fare is greater than in a coach but less than in a Pullman car. Airlines, too, have "sky coach" service, which is less expensive than travel in more luxurious airplanes.

Many transportation companies sell round-trip tickets at a lower price than the charge for two one-way tickets between the same points. They also permit young children to travel free or for half fare.

PROBLEMS

1. Bus fare from Pittsburgh, Pennsylvania, to Detroit, Michigan, is \$6.75 for a one-way ticket and \$12.15 for a round-trip ticket, tax not included. How much can you save on the fare for a trip from Pittsburgh to Detroit and return if you buy a round-trip ticket rather than two one-way tickets?

2. Train fare from Detroit, Michigan, to Pittsburgh, Pennsylvania, is \$10.05 for a one-way coach ticket and \$19.35 for a round-trip coach ticket, tax not included. How much more expensive is it to buy a ticket from Detroit to Pittsburgh and one from Pittsburgh to Detroit than to buy a round-trip ticket?

3. You can go from Buffalo, New York, to Chicago, Illinois, by bus, train, or airplane. The one-way fares, tax not included, are as follows:

Bus		\$11.60
Train:	coach	17.81
	first-class (Pullman)	23.70
	lower berth	5.80
Airplane		29.95

How much less is the bus fare from Buffalo to Chicago than:

a. The fare for railroad coach travel?
b. The fare in a Pullman car with lower berth?
c. The airplane fare?

4. The one-way fares, exclusive of tax, from Miami, Florida, to Boston, Massachusetts, are as follows:

Bus		$29.00
Train:	coach	47.02
	first-class (Pullman)	64.40
	lower berth	15.45
Airplane		87.85

How much more is the airplane fare than:

a. The fare in a Pullman car, with a lower berth?
b. The fare for coach transportation on the railroad?
c. The fare for travel by bus?

5. The distance by rail from St. Paul, Minnesota, to Seattle, Washington, is 1784 miles. A one-way coach ticket costs $46.76. A one-way first-class ticket costs $65.40, and the price of a lower berth is $23.10. Tax is not included. What is the fare per mile from St. Paul to Seattle:

a. By railroad coach?
b. By Pullman car (occupying a lower berth)?

6. The distance by rail from Minneapolis, Minnesota, to Portland, Oregon, is 1822 miles. A one-way coach ticket costs $48.10. A first-class ticket costs $67.25, and an upper berth costs $17.50. Tax is not included. What is the fare per mile from Minneapolis to Portland:

a. By railroad coach?
b. By Pullman car (occupying an upper berth)?

7. When their two children were 3 and 10 years old, Mr. and Mrs. Sanford took them on a vacation trip to Glacier National Park. The family traveled from their home in Helena, Montana, to and from the Park by rail. The railroad coach fare, round trip, for each adult was $13.73. The three-year-old was carried free of charge; the ten-year-old had a half-fare ticket. All fares were subject to a 10 per cent Federal tax. What did the Sanfords' transportation cost them?

8. Mr. and Mrs. Parry took their two children, aged 8 and 4, to visit their grandparents in Sumter, South Carolina. The round-trip adult bus fare from Jacksonville, Florida, where the Parrys live, to Sumter was $12.10. The older child had to have a half-fare ticket, but the younger one was carried free. All fares were subject to a 10 per cent Federal tax. What did the Parrys' transportation cost them?

9. Mrs. Thompson went from Portland, Oregon, to San Francisco by sleeper. Her ticket cost $29.22, and her bedroom cost $15.75, both plus 10 per cent Federal tax. Meals on the train came to $3.85, and tips to $2.10. Mrs. Thompson returned to Portland by air, paying $35.15, plus 10 per cent Federal tax, for her ticket. She had no expenses for meals or tips on the return trip. Which cost more and how much more: her trip by train or her trip by air?

10. Mr. Milligan went from New York to Chicago by Pullman. His first-class ticket cost him $40.89, and his space (a roomette) cost $12.50, both plus 10 per cent Federal tax. He had two meals in the dining car; these cost him $3.00 and $1.75, and each time he left a 25-cent tip. When he left the train, he tipped the Pullman porter $1.00. He returned to New York by air. His air-line ticket cost him $45.10, plus 10 per cent Federal tax. Meals were free, and there was no tipping. Fares to and from airports totaled $2.50. Which trip cost the more and how much more?

Accident Rates

Only about 5 per cent of all fatal transportation accidents involve railroad trains, airplanes, and boats; about 95 per cent are motor vehicle accidents. By far the greatest number of motor vehicle accidents involve private automobiles; few involve buses.

Table 23 shows the number of deaths occurring as a result of various kinds of transportation accidents in a recent year. "Passenger miles" means the number of miles traveled by all passengers; for example, a bus with 40 passengers that made a 50-mile trip would go 2000 passenger miles ($40 \times 50 = 2000$). "Passenger deaths" means the number of passengers killed;

this figure includes the drivers of private automobiles and taxis, but not bus drivers, train crews, or airplane crews. "All deaths" includes pedestrians, trespassers, and crew members killed as a result of the accidents reported.

Table 23. DEATHS OCCURRING AS A RESULT OF TRANSPORTATION ACCIDENTS IN A SINGLE YEAR

Kind of Transportation	*Passenger Miles*	*Passenger Deaths*	*All Deaths*
Passenger automobiles	620,000,000,000	15,400	24,700
Buses	72,000,000,000	140	1,000
Railroad passenger trains	64,800,000,000	115	2,104
Scheduled airplanes	6,067,000,000	75	107

PROBLEMS

Refer to Table 23 as you solve these problems.

1. Find the death rate per 100,000,000 passenger miles traveled by passenger automobiles for:

a. passengers **b.** all persons

2. Find the death rate per 100,000,000 passenger miles traveled by buses for:

a. passengers **b.** all persons

3. Find the death rate per 100,000,000 passenger miles traveled by railroad passenger trains for:

a. passengers **b.** all persons

4. Find the death rate per 100,000,000 passenger miles traveled by scheduled airplanes for:

a. passengers **b.** all persons

5. One year the total number of passenger deaths in American airplane accidents (domestic and international) was 142. The passenger death rate was 1.3 per 100,000,000 passenger miles. What was the total passenger mileage?


It costs money to
save time traveling

What You Have Learned in This Chapter

1. To determine the fixed expenses and the running expenses of owning and operating an automobile
2. To find how much revenue a state receives from gasoline taxes, and how much gasoline taxes cost the car owners
3. To determine the rate of interest paid when buying an automobile on time
4. To find the per cent of automobile accidents resulting from various errors in driving
5. To figure stopping distances of automobiles traveling at various speeds
6. To find time in one section of the United States when you know the time in another section
7. To read timetables of railroads, bus lines, and air lines
8. To compare the costs of traveling by various means
9. To compare the accident rates for different means of transportation
10. To use the following terms correctly: *running expenses, fixed expenses, reaction time*

The ability to read maps is one of the skills travelers need.

Review Test on Going Places

1. Mr. Martin, who lives in a western state, reported the following running expenses on his automobile for a year during which he drove 20,000 miles.

Insurance	$ 85.00
Annual license and registration fee	12.75
Annual depreciation	350.00
Gasoline	372.40
Oil	30.68
Grease	9.32
Repairs and miscellaneous expenses	150.00
Tires	52.50
Garage	48.00

a. What was the total of Mr. Martin's fixed expenses for the year?

b. What was the total of the running expenses for one year?

c. Find the average cost per mile of running this car during the year for which expenses were reported.

2. One year 890,000 motor vehicles were registered in Oklahoma. They consumed 652,000,000 gallons of gasoline. The tax per gallon was 6.5 cents.

a. What was the total revenue received by the state from gasoline sold to motorists?

b. What was the average amount of gasoline used per motor vehicle?

c. What was the average gasoline tax per motor vehicle?

3. Mr. Croft bought a used coupe priced at $925. The sales tax was 3% and the insurance on the car was $54.50. The down payment required was one third of the total cost, and included the $250 that the company allowed Mr. Croft for his old car. The balance was paid in 10 monthly installments of $71.

a. How much did Mr. Croft pay in cash?

b. What rate of interest did he pay?

4. If a driver's reaction time is .8 second, how many feet will his car go at 50 miles per hour before he can apply his brakes?

5. Answer these questions by referring to the air-line timetable that follows:

Table 5			WASHINGTON-TOLEDO-CHICAGO			Table 6
205	535	115	Read Down / Read Up	536	200	110
7 15	5 00	7 30	Lv(ET)............WASHINGTON..............Ar	11 25	5 15	5 45
10 00	—	10 15	Ar....................TOLEDO........(ET)Lv	—	3 05	3 35
10 50	7 45	11 05	Ar(CT)..............CHICAGO..........(CT)Lv	7 30	12 30	1 00

a. How long does it take to go from Chicago, Illinois, to Washington, D. C., on Flight 200?

b. A Chicago business man left home one morning, had lunch in Washington and spent several hours in conference with government officials. He returned to Chicago the same day. On what flights did he travel?

c. At what times can you leave Toledo, Ohio, for Chicago, Illinois, using this air line?

How do you rate?	Excellent	Good	Fair	Poor
	5	4	3	2 or less

CHAPTER 13

GENDREAU

1. Find out what the income and expenditures of your municipality were for last year.
2. Find out how much it cost to erect your school building. How was the necessary money obtained?
3. What are the sources of state government income in your state?
4. Find out how many people are employed by your state government at the present time.
5. Get a Federal income tax blank for the current year and study it in connection with the information given in this chapter.

WHAT YOUR TAXES BUY

GOVERNMENTS — local, state, and Federal — furnish many kinds of services. For example, they provide for education, social welfare, protection, and health and recreation. Since the government is the people, the money for government services comes from the people.

Government Income and Expenditures

When you pay taxes, you are paying for your government. Some taxes pay for the local government; some for the state government; some for the Federal government. But although taxes are of many sorts and provide much revenue, they do not provide all the money your governments need. Governments also borrow money. They issue bonds and use the money received from the sale of the bonds.

Revenue of Local Governments

The term *local governments* refers to these governmental units: (1) the school district; (2) the municipality (city, town, township, or village); (3) the county.

A large part of the money local governments collect comes from taxes on real estate (see Chapter 11, pages 399–400). Some of it comes from licenses and fees, such as building permits. And the state government supplies some of the money required; for example, a state may pay a fixed amount for each pupil each day he is in school.

When an unusually large amount is needed at one time, as for a new high-school building, a local government may issue bonds (see Chapter 8, pages 311–312). In this way, the cost of the building is distributed over a number of years, and the taxpayers of the future, who will profit by having the building, pay part of its cost. Of course, the voters must approve a bond issue.

When a governmental unit issues bonds, it is borrowing money from the purchasers of the bonds. Therefore it must make provision for paying interest and for paying off its debt, just as an individual who borrows money must do. The money set aside for payments on principal is called the *sinking fund.*

A government, like a person, should borrow only as much as can be paid back without hardship. This amount is called the *borrowing capacity.* The borrowing capacity of a government is considered to be 3 per cent of the assessed valuation of the property on which it collects taxes. If the assessed valuation of all the property within a city's limits is $100,000,000 the borrowing capacity of that city is $3,000,000.

PROBLEMS

1. In a recent year, Houston, Texas, had a total income of $25,586,000, of which $18,333,000 came from property taxes. What per cent of Houston's revenue came from property taxes?

2. In a year when the population of Nevada was 160,000, the state collected $10,052,000 in taxes and received $5,405,000 from other governments.

a. What was the total amount that Nevada received from both sources that year?

b. What was the average amount received for each person in the state?

3. The Washington School addition cost the school district $100,000, which was obtained by issuing ten-year bonds valued at $1000 each. The bonds paid 3 per cent interest annually. Ten bonds are to be paid off each year until the debt is paid.

a. How much money must the school budget allow each year for paying off the debt?

b. How much money must be allotted the first year for interest payments on the bonds?

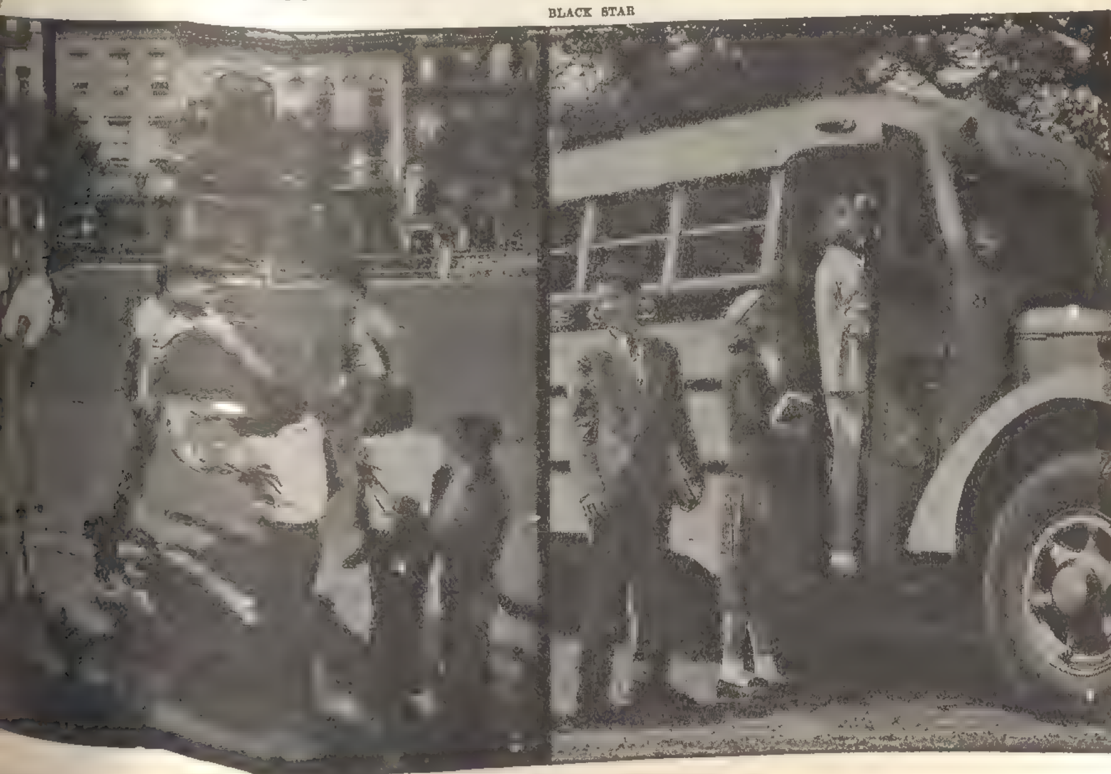
c. How much money must be allotted the tenth year for interest payments on the bonds?

4. The total valuation of the taxable property in Clearhaven is $36,500,000. The town's present indebtedness amounts to $550,000. Its borrowing capacity is 3 per cent of the assessed valuation. The town planning board has recommended a bond issue of $500,000 to pay for a new and greatly-needed town hall. If you were a citizen of Clearhaven, would you vote in favor of the bond issue? Give figures to support your answer.

5. At various times, Plains City, with the consent of the voters, has issued bonds to mature in 25 years, paying $3\frac{1}{2}$ per cent interest. The total assessed valuation of the taxable property within the city limits is $6,525,000. At the beginning of the current year, Plains City had the following debts:

Money paid in taxes on real estate enables the local government to operate schools and transportation for students, and makes possible playgrounds and other recreation facilities.

BLACK STAR



Fire Department	$14,000
Department of Sanitation	16,000
Street Department	15,000
City Hospital	22,000
Electric Power Plant	59,000
Waterworks	48,000

a. Find the total of the city debt.

b. How much must this year's budget allow for interest on the debt?

c. How much must the city put into the sinking fund this year in order that the bonds may be paid in full when they mature? (*Hint:* $\frac{1}{25}$ of the total debt must be put into the sinking fund each year.)

d. Would Plains City be justified in floating a new bond issue of $125,000 to pay for a public library? Its borrowing capacity is 3 per cent of the assessed valuation. Give figures to support your answer.

Sources of State Revenue

You know some of the sources of state revenue: the state sales tax (Chapter 5, pages 200–201), the gasoline tax (Chapter 12, page 420), and the payroll tax for unemployment insurance benefits (Chapter 9, pages 349–350). Property taxes furnish comparatively little revenue in most states. Some states tax individual incomes, and some states tax the earnings of business concerns. All states tax alcoholic beverages; some of them maintain a monopoly on the sale of alcoholic beverages, operating "state stores" for the purpose.

State governments, like local governments, often issue bonds to pay for permanent improvements.

PROBLEMS

1. At the beginning of a recent year, a state government had debts amounting to $43,893,000. During that year, it paid off $5,627,000 of the debt, and issued new bonds amounting to $451,000. What was the debt at the end of the year?

2. One year a state issued new bonds to the amount of $6,333,000, and paid off old bonds to the amount of $9,842,000. What was its debt at the end of the year, if the debt at the beginning of the year was $66,643,000?

3. One year South Dakota collected $41,954,000 in state taxes and received $17,124,000 from other governments. The state's total income that year was $68,761,000.

DEVANEY

A state's government is centered in its capitol. Here is the capitol building at Lincoln, Nebraska.

a. What per cent of the total came from other governmental units?

b. What per cent of the total income came from taxes?

c. How much of the total income came from other sources than the two named?

4. One year the state of Utah collected revenue as follows:

Gasoline	$ 8,486,000
Alcoholic beverages	783,000
Other sales taxes	19,053,000
Licenses and privileges	4,291,000
Income taxes	8,477,000
Property taxes	7,113,000
Unemployment compensation . .	3,375,000
Miscellaneous	1,725,000

What was the total amount of money collected in state taxes in Utah that year?

5. In a recent year the state of North Dakota collected state taxes as follows:

Gasoline	$6,510,000
Alcoholic beverages	3,344,000
Other sales taxes	15,723,000
Licenses and fees	7,623,000

Income taxes	\$5,163,000
Property taxes	3,986,000
Unemployment compensation . .	1,798,000
Miscellaneous taxes	139,000

What was the total collected by North Dakota that year?

Sources of Federal Revenue

The money the Federal government collects in taxes from sources entirely within this country is called *internal revenue.* Internal revenue includes receipts from income taxes; from *excise taxes* on the manufacture, sale, and use of goods and services; from estate and gift taxes; and so on. Internal revenue also includes employment taxes; but employment taxes are earmarked for such purposes as paying social security benefits, and cannot be used for general expenses. Consequently, in reports of the income of the Federal government, you usually find the items listed separately.

The Federal government also collects money on goods brought into this country from abroad; this money is called *customs* or *duties*. When the charge is a per cent of the value of the goods, it is called an *ad valorem* duty. A tax per article, or weight, or yard, regardless of the value, is called a *specific* duty. The Federal government also borrows money, as you know (see Chapter 8, pages 303–304).

GENDREAU

The tax you pay when you go to the circus (even if you have a pass) helps pay the expenses of the Federal government.

PROBLEMS

1. In 1954 a number of Federal excise taxes were lowered as shown in the two per cents given in each of the following problems. Find the tax and total cost using each rate:

a. A $1.50 ticket to a baseball game. (20%, 10%)
b. Lodge dues of $4.50. (20%, 10%)
c. A fur coat priced at $329.75. (20%, 10%)
d. A watch priced at $75.50. (20%, 10%)
e. A telephone bill consisting of a $5.50 charge for local service (15%, 10%) and two long-distance charges of $.85 and $3.25. (25%, 10%)

2. Find the Federal excise tax and total cost of each of the following using each tax rate:

a. An airplane ticket costing $87.12. (15%, 10%)
b. Eight light bulbs at 15 cents each. (20%, 10%)
c. A traveling bag priced at $18.75. (20%, 10%)
d. A diamong ring priced at $175. (20%, 10%)
e. A telegram on which the cnarge is $1.85. (15%, 10%)

3. In a year when the excise tax on jewelry was 20 per cent, the Federal government collected $234,614,142.

a. This tax was 20 per cent of what amount?
b. What was the total cost of the jewelry including tax?

4. In a year in which the tax on long-distance telephone messages and on telegrams was 25 per cent, $417,568,272 was collected.

a. This is 25 per cent of what amount?
b. What was the total cost of the messages, including tax?

5. The Federal government collects duties on many articles brought into United States from foreign countries. Find the duty and the total cost of the following:

a. A camera priced at $135.50. (20%)
b. A $110 watch on which there is a specific duty of $4.50 and an ad valorem duty of 45 per cent.
c. A shipment of micrometers valued at $1050 on which there is a duty of 45 per cent.

6. Find the duty and the total cost of the following:

a. Motion-picture film valued at $320 on which the duty is 20 per cent.

b. Twenty-five clocks costing $7.50 each on which there is a specific duty of $3.00 each and an ad valorem duty of 25 per cent.

c. A bedspread valued at $25.50 with a duty of 25 per cent.

d. Six thousand three hundred pounds of meat at 50 cents per pound with a duty of 5 cents per pound.

e. Imported cutting tools valued at $3250 on which the duty is 45 per cent.

7. In a year when the total internal revenue collections in United States were $69,686,535,389, the amount collected from excise taxes was approximately 15.5 per cent of the total. How much was collected in excise taxes?

8. In a year when the total internal revenue collections were $65,010,000,000, fifty and six-tenths per cent came from individual income taxes, and thirty-three per cent came from corporation income and profits taxes. Find the amount collected from each source.

9. One year the Federal government collected the following amounts in internal revenue: corporation income and profit taxes, $21,595,000,000; individual income taxes, $36,982,000,-000; gift taxes, $107,000,000; estate taxes, $985,000,000; alcohol, $2,781,000,000; tobacco, $1,655,000,000; documents and playing cards, $90,000,000; manufacturers' excise taxes, $2,863,-000,000; retail excise taxes, $2,661,000,000; others, $2,061,-000,000.

a. Find how much was collected that year.

b. A common way to write $100,000,000 is "$100 million." Write in this way your answer to part **a** of this problem.

10. One year the Federal government received part of its revenue in excise taxes from the following sources:

Automobile and motorcycle purchasers .	$ 785,716,000
Estates	784,590,000
Electric, gas, and oil appliance purchasers .	113,390,000

The naval hospital at Bethesda, Maryland (just outside of Washington) is operated by the Federal government. You have probably seen it mentioned in newspaper articles.

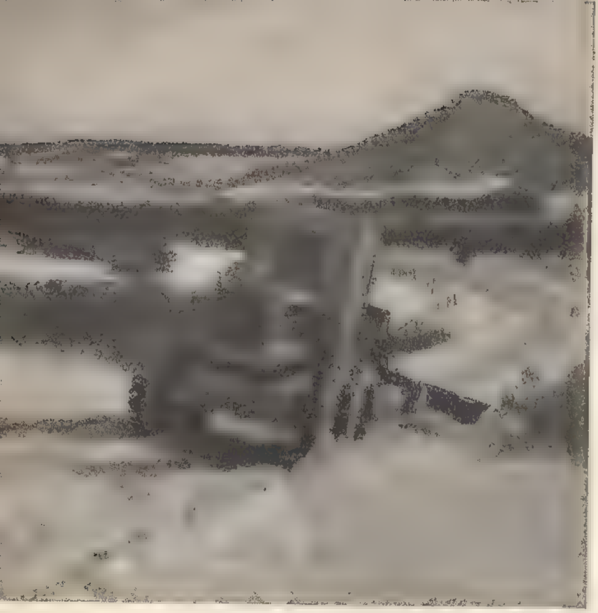
Gasoline purchasers	890,679,000
Importers (customs and duties) . . .	613,000,000
Local telephone subscribers	357,981,000
Radio, phonograph, television purchasers.	159,383,000
Travelers	287,405,000
Theater and concert goers	312,831,000

Find the total collected from these sources.

How Your Governments Spend Their Money

Your local governments enter into almost every phase of your life. You go to school; you use streets and highways; you eat food from government-inspected markets; you drink milk and water that your government has checked for purity; you see movies in theaters that your government has inspected for safety; you have your hair cut in barber shops or beauty shops that your government approves as clean and sanitary. All these services and many others are provided for in the budget of a local governmental unit.

Your state government gives financial aid to your local governments. In addition, it furnishes you and other citizens of your state with many other services. Some of these services are familiar to you — the state university and teachers colleges, the state employment service (see Chapter 9, page



GALLOWAY

Many states must spend money to clear snow from state highways. Here a snowplow makes a road passable.

420), highways, and state recreation areas and forests. Others you may not know about are the mediation board to help settle strikes, the commission for the development and conservation of natural resources, the crime detection laboratories, and the public health laboratories. In addition, state money is spent for public safety, for hospitals, for institutions for the handicapped, for corrective institutions (reform schools and prisons), for libraries, and for salaries of public officials. Provision must be made for paying off debts and for paying interest on bonds.

Some of the services furnished by the Federal government are similar to those furnished by the state and local governments. But the Federal government operates on a much larger scale: Federal projects in the fields of conservation and power development, for example, extend across state boundaries; the armed forces defend the entire nation; the diplomatic service protects American interests all over the world.

PROBLEMS

1. The Melrose school district spent $855,300 on its schools one year. These expenses were divided as follows:

Payments of debts and interest	8.2%
Cost of instruction	61.8%
Maintenance of school plant	6.1%
Operation, repair, and new buildings	11.2%
Teacher retirement system	4.9%
Lunches, garden, and recreational activities . .	1.5%
Other expenses	6.3%

Find how much money was spent for each item.

2. One year the city of Westland spent $4,100,000 as follows:

Administration: mayor, council, law department, finance department, boards and commissions	$ 440,000
Health and Welfare: City hospital, health, welfare institutions, air pollution	590,000
Properties: Airport, parks, markets, cemeteries	770,000
Service: streets, engineering, garbage collections, sewers, bridges, etc.	680,000
Safety: police and fire protection, inspection of buildings	1,620,000

What per cent of the total was spent for each item?

3. In a year when the population of Texas was 7,673,000, the state spent $478,000,000, including aid given to local governments. How much was this for each person in the state?

4. The amount of money spent by the state of Pennsylvania, in a year, including that paid to local governments and to the unemployment compensation fund, amounted to an average of $94.44 per person. The population of the state that year was 10,498,000. How much money was spent?

5. The total amount of money spent for operating expenses in one year in Illinois averaged $58.71 per person. Part of this was distributed as follows: highways, $12.74; health, $.81; hospitals and institutions for the handicapped, $6.31; public welfare, $16.36; and schools, $12.59. What per cent of the total was spent for each of these items?

6. One year the total amount spent for operating expenses in California was $1,199,630,000. Part of this was spent as follows: highways, $193,900,000; health, $9,963,000; hospitals and institutions for the handicapped, $74,006,000; public welfare, $303,450,000; and schools, $334,988,000.

a. Express each amount to the nearest million dollars.
b. Find what per cent of the total was spent for each item.

7. Michigan's expenses for one year were distributed as follows: debt reduction, $17,508,000; operation, $236,646,000; new construction, $65,941,000; aid to local governments,

$251,192,000; interest, $4,256,000; and unemployment compensation fund, $68,839,000.

a. Express each amount to the nearest million dollars.

b. Find the total.

c. What per cent of the total was spent for operation?

d. What per cent was devoted to aid to local governments?

8. One year Ohio spent $378,196,000 for operating expenses. Of this amount the following per cents were for educational purposes: public schools, 23.8%; State University, 7.5%; other state schools, 3.9%; administration of public education, .6%; visual and vocational education, .6%.

a. How many dollars (to the nearest thousand) were spent for each item?

b. What was the total amount spent for education?

9. One year the Federal budget of expenditures was approximately sixty-two billion dollars. This was budgeted as follows: military services, 59%; international expenses, 9%; veterans services, 6%; interest, 9%; other expenses, 17%. Find, to the nearest $ million, the amount budgeted for each.

10. One year the Federal expenditures were approximately 74.6 billion dollars (which may be expressed as "$74.6 billion"). Part of this was spent as follows: legislative branch, $60 million; judiciary, $27 million; agriculture, $2,733 million; health, education, and welfare, $1906 million; housing and home finance agency, $501 million; Justice Department, $172 million; Labor Department, $300 million; Post Office Department, $719 million; State Department, $266 million; and Tennessee Valley Authority, $189 million.

a. Express each item as a complete number in dollars.

b. Find the total amount spent by these departments.

Your Federal Income Tax

The Federal income tax law is often changed. But certain *kinds* of provisions are always included in the law. If you understand the various kinds of provisions, you will be able to find out how they apply to you.

There is only one fact that determines whether or not you file an income tax return — the amount of your total annual

income. It does not matter whether you are 17 or 70 years old, whether you are a man or a woman, married or single, a citizen or an alien. The only thing that matters is the amount of your income. The Congress decides what is the largest income you may have without filing a return; in recent years, everyone with an annual income of $600 or more has been required to fill out an income tax report. Figure 13–1, on the next page, shows the first page of an income tax return.

Although no one with an income of the amount fixed by Congress has any choice about whether or not to file a return, everyone does not file the same kind of return. You may be able to choose between a "short form," which requires you to use a tax table, and a "long form," which requires you to compute correctly. Married persons can decide whether to file two separate returns or one joint return. When you get married, you will want to investigate the joint return. This discussion is limited to returns made by one person.

It may be that you already have had to file an income tax return. Almost certainly you will have to file one in a few years. Therefore you should understand how your income tax is figured. Although the specific details change from year to year, the general principles remain the same.

Exemptions

An exemption represents a certain sum on which you do not pay an income tax. The exemption is changed from time to time; in recent years it has been either $500 or $600.

Each person filing a return may claim a *personal exemption.* He may also take one exemption for each *dependent.* A person is a dependent if these four statements are true of him: (1) He gets more than half his support from the person filing the return. (2) He is closely related by blood, marriage, or adoption to the person filing the return. A cousin is not considered "closely related"; a mother-in-law is. (3) His own total annual income is less than a fixed amount. The amount in recent years has been $600. (4) He lives in the United States, Canada, or Mexico.

FORM 1040
U. S. Treasury Department
Internal Revenue Service

U. S. INDIVIDUAL INCOME TAX RETURN

FOR CALENDAR YEAR 1953

1953

or taxable year beginning ...., 1953, and ending .... , 195...

Do not write in these spaces

Serial No.

(Cashier's Stamp)

Name ....
(PLEASE PRINT. If this is a joint return of husband and wife, use first names of both)

HOME ADDRESS ....
(PLEASE PRINT. Street and number or rural route)

....
(City, town, or post office) (Postal zone number) (State)

Social Security No. .... Occupation ....

Your exemptions

1. List your name. If your wife (or husband) had no income, or if this is a joint return, list also her (or his) name.
   A..
   B..
   (Your wife's name—do not list if she is filing a separate return or if she had income not included in this return)

Check below if at the end of your taxable year you or your wife were—
65 or over ☐ Blind ☐
65 or over ☐ Blind ☐

On lines A and B below—
If neither 65 nor blind write the figure 1
If either 65 or blind write the figure 2
If both 65 and blind write the figure 3

Number of exemptions for you ....
Number of her (or his) exemptions..

Name—and address if different from yours

C. List names of your children (including stepchildren and *legally* adopted children) with 1953 gross incomes of less than $600 who received more than one-half of their support from you in 1953. See Instructions.
   Enter number of children listed.....

D. Enter number of exemptions claimed for other close relatives listed in Schedule I on page 2.....

E. Enter total number of exemptions claimed in A to D above ....

— — Please Attach All Original W-2 Forms Here — —

Your income

2. Enter your total wages, salaries, bonuses, commissions, and other compensation received in 1953, *before payroll deductions*. Persons claiming traveling or reimbursed expenses, see Instructions.

Print Employer's Name	Where Employed (City and State)	Total Wages	Income Tax Withheld
		$	$
	Enter total →		

3. If you received dividends, interest, or any other income (or loss), give details on page 2 and enter the total here .... $
4. Add amounts shown in items 2 and 3, and enter the total here ... $

How to figure the tax

(Unmarried or legally separated persons qualifying under Schedule J as "Head of Household," check here ☐.)
IF YOUR INCOME WAS LESS THAN $5,000.—Use the tax table on page 4 *unless you itemize deductions*. The table allows about 10 percent of your income for charitable contributions, interest, taxes, medical expenses, etc. If your deductions exceed 10 percent, it will usually be to your advantage to itemize them and compute your tax on page 3.
IF YOUR INCOME WAS $5,000 OR MORE.—Compute tax on page 3. Use standard deduction or itemize deductions, whichever is to your advantage.

Tax due or refund

5. (A) Enter your tax from table on page 4, or from line 13, page 3 . $
   (B) Enter your self-employment tax from line 35, separate Schedule C.
   Enter total here → $
6. How much have you paid on your 1953 income tax?
   (A) By tax withheld (in item 2, above). Attach Original Forms W-2. $
   (B) By payments on 1953 Declaration of Estimated Tax (include any overpayment on your 1952 tax not claimed as a refund)
   Enter total here →
7. If your tax (item 5) is larger than payments (item 6), enter *balance of tax due* here. This balance must be paid in full with return .... $
8. If your payments (item 6) are larger than your tax (item 5), enter the *overpayment* here → $
   Enter amount of item 8 you want $.................... (Credited on 1954 estimated tax) $.................... (Refunded)

Do you owe any prior year Federal tax for which you have been billed? (Yes or No) ...... Is your wife (or husband) making a separate return for 1953? (Yes or No) ...... If "yes," write her (or his) name ....
If you have filed a return for a prior year, state latest year 19 .... Where filed? ....
To which District Director's office did you pay amount claimed in item 6 (B), above? ....

I declare under the penalties of perjury that this return (including any accompanying schedules and statements) has been examined by me and to the best of my knowledge and belief is a true, correct, and complete return.

.... (Signature of person, other than taxpayer, preparing this return) (Date)

.... (Signature of taxpayer) (Date)

.... (Name of firm or employer, if any)

.... (Signature of taxpayer's wife or husband if this is a joint return) (Date)

➧ To assure split-income benefits, husband and wife must include all their income and, even though only one has income, BOTH MUST SIGN. 16—66180-1

Figure 13-1

PROBLEMS

1. In a year in which the amount allowed for an exemption was $600, Mr. Smith, a widower, had four small children. The family's only income was Mr. Smith's salary.

a. How many exemptions could Mr. Smith claim?
b. How much of Mr. Smith's income was exempt from tax?

2. Miss Andrews' salary was $58 a week in a year when an exemption was valued at $500. She and her mother lived together on her salary and her mother's pension of $30 a month. Miss Andrews had no other dependents. How much of her income was exempt from tax?

3. In a year when the amount allowed for an exemption was $600, Marvin Henderson supported his father, his wife, two adopted children, and his wife's cousin. How much of his income was not subject to tax?

4. Mrs. Chamberlain had no income of her own. Her daughter sent her $40 a month last year, and her son sent her $200 in April, $200 in August, and $200 in December. If either of Mrs. Chamberlain's children can claim her as a dependent, which one can?

5. The Day family consists of Mr. and Mrs. Day and James. Until James graduated from high school, in June, 1948, their only source of income was Mr. Day's salary. James got a job paying $125 a month immediately upon graduation. That year the amount allowed for an exemption was $600; in previous years it was $500.

a. How much of Mr. Day's income was not subject to tax in 1947?
b. How much of Mr. Day's income was exempt in 1948?
c. What exemption, if any, could James claim when he filed his 1948 tax return?

Reporting Your Total Income

The law requires your employer to hold back a part of your wages each pay day and turn them over to the government to be applied on your income tax. The amount withheld is

determined by your salary and by the number of exemptions you claim. The government supplies your employer with tables that tell him how much to withhold from your salary. At the end of the year, your employer gives you a statement called a *withholding statement* (see Figure 13-2), which shows your total salary and the amount withheld. You report these amounts to the government. You also report your income from all other sources. This income may be interest on invested money, dividends on stocks, rent, or money earned by working "on the side" at other jobs.

When your salary is less than $5000 a year and your income from all other sources (such as interest on savings) is less than $100, you may file a "short form" income tax return. You will probably find that you need do no more about your income tax. The government has figured the amount for you, and your employer has collected it in installments and has paid it to the government. If you should owe the government more money, you will receive a bill for it.

When your salary is more than $5000 a year or when your income from other sources is over $100, you must file a "long form" income tax return. Your employer has collected only part of your income tax. You must report the total amount of your income to the government. You must also figure your total tax, and pay the government that part of your tax that your employer has not already collected.

Figure 13-2

Form W-2
U. S. Treasury Department
Internal Revenue Service

ORIGINAL

WITHHOLDING STATEMENT—1953

Federal Taxes Withheld From Wages

FEDERAL INSURANCE CONTRIBUTIONS ACT (FEDERAL OLD-AGE AND SURVIVORS INSURANCE)		U. S. INCOME TAX WITHHOLDING INFORMATION (TO BE REPORTED ON EMPLOYEE'S INCOME TAX RETURN)	
Total F.I.C.A. wages (before payroll deductions) paid in 1953*	F.I.C.A. employee tax withheld, if any	Total wages (before payroll deductions) paid in 1953	Federal income tax withheld, if any
$	$	$	$

EMPLOYEE (Print employee's social security account number, name, and full address below)

EMPLOYER (Print employer's identification number, name, and address below)

*If your wages were subject to F.I.C.A. taxes, but are not shown above, your F.I.C.A. wages are the same as wages shown under "U. S. INCOME TAX WITHHOLDING INFORMATION," but not more than $3,600.

NOTICE TO EMPLOYEE: This statement is important, and should no[t] be lost or mislaid. It must be attached to your U.S. income tax return [for] 1953. SEE OTHER SIDE.

16—67319-1

A person who does not have a regular salary — for example, a farmer, or a man who is in business for himself, or a doctor — must report his receipts and expenses in some detail. His profits are his income.

There are special rules for persons who have income from insurance policies and pensions. For instance, money received from an accident policy is not subject to income tax. Neither are social security benefits and pensions paid to a veteran or a veteran's widow.

PROBLEMS

1. Jack Harris earned \$65 a week last year, from which income tax deductions were made by his employer. As he was buying a car, he did not save any money during the year, but neither did he withdraw any money from his savings account. At the beginning of the year he had \$1823.46 in the bank, earning interest at 2 per cent compounded semiannually. What income, if any, did Jack have to report in addition to his salary?

2. Joseph Addams earned \$350 monthly last year, from which income tax payments were withheld. He owned a \$1000 corporation bond bearing interest at 3 per cent per year, and had \$2378.49 in his savings account, which bore interest at $1\frac{1}{2}$ per cent compounded semiannually. During the year he neither deposited nor withdrew money, but invested his savings in government bonds. (He need not report the interest on his government bonds until they mature.) What income did he have to report?

3. Last year Virginia Cunningham worked five days a week as a stenographer at a salary of \$37.50 a week. To earn extra money, she took subscriptions to three magazines, receiving a 30 per cent commission. Last year she obtained 26 subscriptions at \$5 each; 45 subscriptions at \$4.50 each, and 77 subscriptions at \$3.75 each. How much income did she have to report when she filed her income tax return?

4. Mr. Frazee is retired. The company for which he worked pays him a pension of \$100 per month. As he made no contributions to this pension when he was working, he must pay

an income tax on the amount he receives. He also receives \$42.75 a month in social security benefits. A savings account, which he did not use last year, contained \$2134.57 at the beginning of the year; it pays $1\frac{1}{2}$ per cent interest, compounded semiannually. What income must Mr. Frazee report?

5. Mr. Stone has his own business manufacturing plastic novelties. His income is the net profit from his business. The portion of his income tax return giving the details required is shown below:

a. Find the net cost of the goods sold (line 9).
b. Find the gross profit (line 10).
c. Find the net profit (line 23).

1. Total receipts from business or profession		\$92,480.00
COST OF GOODS SOLD		
2. Inventory at beginning of year	\$16,570.00	
3. Merchandise bought for manufacture or sale	23,440.00	
4. Cost of labor	16,200.00	
5. Material and supplies	1,800.00	
6. Other costs (explain in Schedule C–2)	2,975.00	
7. Total of lines 2 to 6	\$	
8. Less inventory at end of year	14,300.00	
9. Net cost of goods sold (line 7 less line 8)		
10. Gross profit (line 1 less line 9)		\$
OTHER BUSINESS DEDUCTIONS		
11. Salaries and wages not included in line 4	\$5,897.50	
12. Rent on business property	None	
13. Interest on business indebtedness	18.94	
14. Taxes on business and business property	398.56	
15. Losses of business property (attach statement)	1,200.00	
16. Bad debts arising from sales or services	245.00	
17. Depreciation and obsolescence (explain in Schedule C-1)	4,500.00	
18. Repairs (explain in Schedule C–2)	4,215.00	
19. Depletion of mines, oil and gas wells, timber, etc. (submit schedule)		
20. Amortization of emergency and grain storage facilities (attach statement)	None	
21. Other business expenses (explain in Schedule C–2)	None	
22. Total of lines 11 to 21		
23. Enter net profit (or loss) (line 10 less line 22). Also enter on line 24, page 3, and on line 1, Schedule C Summary, Form 1040		\$

Deductions

The law requires you to report your entire income, but it also allows you to make certain deductions from it before figuring your tax. Most persons can make five kinds of deductions, as follows:

(1) *Contributions* to religious, charitable, and educational organizations. There is a limit on this deduction, which has been fixed at 15 per cent of your income. Thus a man with a total income of \$10,000 may deduct as much as \$1500 for contributions, provided that he can prove he really made them.

(2) *Interest paid* on loans. If you are buying a house, for example, you may deduct your interest payments from your income.

(3) *Taxes.* Not all taxes may be deducted, but some can. In general, you may deduct the taxes you pay to your local and state governments. Most Federal taxes may not be deducted.

(4) *Losses from* fire, storm, theft, or other cause. If you suffer a loss not covered by insurance, you may deduct the amount of your loss from your income.

(5) *Medical and dental expenses* not covered by insurance. You can deduct the amount by which your medical and dental expenses exceed 5 per cent of your income. Suppose that you had an income of $2000 and spent $150 for medical and dental care. Since 5 per cent of $2000 is $100, you would deduct $50 from your income before figuring your tax.

PROBLEMS

1. Mr. Beardsley had a total income of $11,500. During the year he contributed $500 to the Community Fund, $500 to his church, $200 to the college from which he graduated, and $50 each to seven welfare and relief groups. How much may Mr. Beardsley deduct for contributions?

2. Miss Jones has a total annual income of $2200. Last year she contributed $1.00 a week to her church, and gave the Community Fund $10.00 a quarter (four times during the year). She also gave $10.00 to the Children's Hospital and $5.00 to the Red Cross. How much may Miss Jones deduct for contributions?

3. Mr. Marsten has an $8000 mortgage on his house, on which he pays $4\frac{1}{2}$ per cent interest. He purchased furniture on an installment plan that provided for 10 payments of $95, each plus $5 interest. How much may he deduct from his income on account of interest payments?

4. Mr. Byram paid property taxes amounting to $232.06 and a state income tax of $80. During the year he bought 370 gallons of gasoline in his own state, in which the tax was

3 cents per gallon, and 140 gallons in a neighboring state in which the tax was 4 cents per gallon. His automobile registration cost him $10.40 and his driver's license $3. These taxes were all deductible for income tax purposes. How much could Mr. Byram deduct from his income on account of these taxes?

5. Mr. Gregory had insured his house and its contents for $9500, and he did not change the insurance when he purchased new furniture. During the past year, his house was destroyed by fire, and the actual loss amounted to $12,300. How much may Mr. Gregory deduct as a loss on his income tax return?

6. Miss Carney's adjusted gross income is $4000. She requires medical treatments twice a week, each of which cost her $4.00. During the year she spent $48 on prescribed medicines, and paid dentist bills amounting to $76. How much may Miss Carney deduct for medical expenses?

7. Miss Stern's adjusted gross income is $3250. She visited her physician once each month last year, paying $5 each time, and spent $16.84 on medical supplies. Her semiannual dental bills were $24 and $104. She needed new glasses, for which she paid $23, plus an oculist's bill of $15. How much could Miss Stern deduct for medical and dental expenses?

8. Mr. Jensen's income last year was $5350. His contributions amounted to $250; his deductible taxes came to $438.27; his medical and dental bills totaled $210. He made no interest payments. During the year he lost a diamond ring valued at $700. What was the total allowable deduction?

9. Mr. Gossett's income was $4800. His accounts showed the following expenditures:

Contributions	$580.00
Interest payments	400.00
Deductible taxes	556.25
Medical and dental	250.00

How much could he deduct in all?

10. Mr. Grant's income one year was $7200. His accounts showed the following expenditures:

Contributions	$1200.00
Interest payments	250.50
Deductible taxes	677.78
Medical and dental	550.00

What was the total allowable deduction?

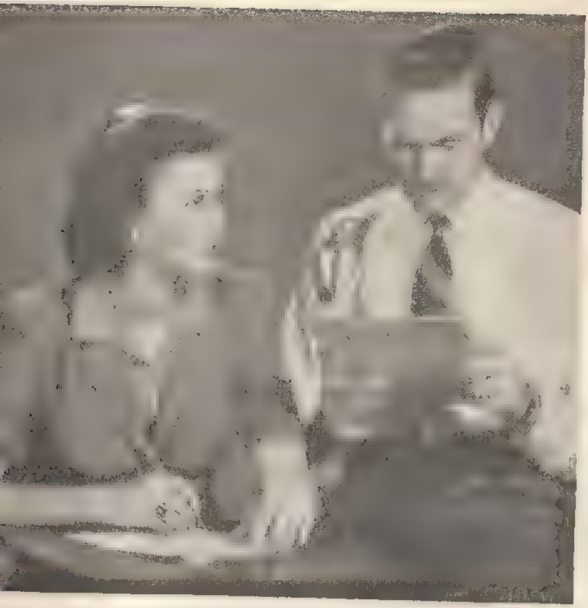
When to Use the Tax Table

It has been found that the average deduction is 10 per cent of the total income. So the law allows you to take a *standard deduction* of 10 per cent of your income instead of figuring out your deductions. The largest standard deduction allowed is fixed by law. In some years it has been $1000. In others it has been $500.

Whether you use the standard deduction or list your deductions is up to you. You save money by choosing the standard deduction if your deductions are less than 10 per cent of your income (or less than the fixed amount, if your income is over $5000); you save money by itemizing your deductions if they are greater than 10 per cent of your income.

If your income (Item 4, page 1, Form 1040) is expected to be—		And the number of your 1954 exemptions is—			
At least	But less than	1	2	3	4 or more
		Your estimated tax is—			
$0	$675	$0	$0	$0	$0
675	700	4	0	0	0
700	725	8	0	0	0
725	750	13	0	0	0
750	775	17	0	0	0
775	800	22	0	0	0
800	825	26	0	0	0
825	850	31	0	0	0
850	875	35	0	0	0
875	900	40	0	0	0
900	925	44	0	0	0
925	950	49	0	0	0
950	975	53	0	0	0
975	1,000	58	0	0	0
1,000	1,025	62	0	0	0
1,025	1,050	67	0	0	0
1,050	1,075	71	0	0	0
1,075	1,100	76	0	0	0
1,100	1,125	80	0	0	0
1,125	1,150	85	0	0	0
1,150	1,175	89	0	0	0
1,175	1,200	94	0	0	0
1,200	1,225	98	0	0	0
1,225	1,250	103	0	0	0
1,250	1,275	107	0	0	0
1,275	1,300	112	0	0	0
1,300	1,325	116	0	0	0
1,325	1,350	121	1	0	0
1,350	1,375	125	5	0	0
1,375	1,400	130	10	0	0
1,400	1,425	134	14	0	0
1,425	1,450	139	19	0	0
1,450	1,475	143	23	0	0
1,475	1,500	148	28	0	0
1,500	1,525	152	32	0	0
1,525	1,550	157	37	0	0
1,550	1,575	161	41	0	0
1,575	1,600	166	46	0	0
1,600	1,625	170	50	0	0
1,625	1,650	175	55	0	0
1,650	1,675	179	59	0	0
1,675	1,700	184	64	0	0
1,700	1,725	188	68	0	0
1,725	1,750	193	73	0	0
1,750	1,775	197	77	0	0
1,775	1,800	202	82	0	0
1,800	1,825	206	86	0	0
1,825	1,850	211	91	0	0
1,850	1,875	215	95	0	0
1,875	1,900	220	100	0	0
1,900	1,925	224	104	0	0
1,925	1,950	229	109	0	0
1,950	1,975	233	113	0	0
1,975	2,000	238	118	0	0
2,000	2,025	242	122	2	0
2,025	2,050	247	127	7	0
2,050	2,075	251	131	11	0
2,075	2,100	256	136	16	0
2,100	2,125	260	140	20	0
2,125	2,150	265	145	25	0
2,150	2,175	269	149	29	0
2,175	2,200	274	154	34	0
2,200	2,225	278	158	38	0
2,225	2,250	283	163	43	0
2,250	2,275	287	167	47	0
2,275	2,300	292	172	52	0
2,300	2,325	296	176	56	0

Figure 13-3


KEYSTONE

Filing an income tax return calls for problem-solving skills. You must read directions carefully, know what facts you need, and compute accurately.

If your total income is less than $5000, you may use a table to find the amount of your tax. The table, provided on the income tax blank, automatically allows a standard deduction. So, if your deductions are less than 10 per cent of your income, in general you save money by using the tax table; if your deductions are more than 10 per cent of your income, you save money by computing your tax.

Figure 13–3, page 469, shows part of a recent tax table. To use it, find the total income in the first two columns, and then read across to the column headed by the number of your exemptions. For example, if you have an income of $1360 and one exemption, your tax is $125.

PROBLEMS

Refer to Figure 13–3, page 469, as you solve these problems. The incomes given were earned during the year that table was in effect.

1. Mollie Parker had an income of $2100. Her deductions totaled less than $200. She was permitted two exemptions.

a. What was her tax?

b. Do you think she should have used the tax table?

2. Richard Reilley earned $1210. His deductions totaled $95. He could claim only his personal exemption. He used the tax table to find his tax. How much was it?

3. Sam Murray was a junior in high school. His earnings that year amounted to $728. His deductions amounted to $54. He could claim only his own exemption. According to the tax table, how much was his income tax?

4. Mrs. Bryant had an income of $1545 in addition to her pension as a widow of a soldier killed in World War II. She claimed exemptions for herself and her two small children. What income tax did she pay? (Her pension was not taxed.)

5. Bob Burfield earned $2300. He had two dependents, and his deductions were $200. What income tax did he pay?

Computing Your Tax

If your total income is more than $5000, you must compute your tax; you cannot use the tax table. If your income is less than $5000, you *may* compute your tax, and you should do so if your deductions are more than 10 per cent of your income. Your tax is figured on your *net taxable income.* To find the net taxable income, subtract your deductions and the amount allowed for exemptions from your total income. Then use the *tax rate schedule* supplied with your income tax blank. Figure 13–4 shows a recent tax rate schedule.

Figure 13–4

Tax Rate Schedule

Use this schedule to determine your "tentative tax" on the income you show on either line 5 or line 8(a), page 3, of the return:

If the amount on Line 5 or 8(a) is:	Enter on Line 7 or 8(b):
Not over $2,000	20% of the amount on line 5 or 8(a).
Over $2,000 but not over $4,000	$400, plus 22% of excess over $2,000.
Over $4,000 but not over $6,000	$840, plus 26% of excess over $4,000.
Over $6,000 but not over $8,000	$1,360, plus 30% of excess over $6,000.
Over $8,000 but not over $10,000	$1,960, plus 34% of excess over $8,000.
Over $10,000 but not over $12,000	$2,640, plus 38% of excess over $10,000.
Over $12,000 but not over $14,000	$3,400, plus 43% of excess over $12,000.
Over $14,000 but not over $16,000	$4,260, plus 47% of excess over $14,000.
Over $16,000 but not over $18,000	$5,200, plus 50% of excess over $16,000.
Over $18,000 but not over $20,000	$6,200, plus 53% of excess over $18,000.
Over $20,000 but not over $22,000	$7,260, plus 56% of excess over $20,000.
Over $22,000 but not over $26,000	$8,380, plus 59% of excess over $22,000.
Over $26,000 but not over $32,000	$10,740, plus 62% of excess over $26,000.
Over $32,000 but not over $38,000	$14,460, plus 65% of excess over $32,000.
Over $38,000 but not over $44,000	$18,360, plus 69% of excess over $38,000.
Over $44,000 but not over $50,000	$22,500, plus 72% of excess over $44,000.
Over $50,000 but not over $60,000	$26,820, plus 75% of excess over $50,000.
Over $60,000 but not over $70,000	$34,320, plus 78% of excess over $60,000.
Over $70,000 but not over $80,000	$42,120, plus 81% of excess over $70,000.
Over $80,000 but not over $90,000	$50,220, plus 84% of excess over $80,000.
Over $90,000 but not over $100,000	$58,620, plus 87% of excess over $90,000.
Over $100,000 but not over $150,000	$67,320, plus 89% of excess over $100,000.
Over $150,000 but not over $200,000	$111,820, plus 90% of excess over $150,000.
Over $200,000	$156,820, plus 91% of excess over $200,000.

Example

Mr. Jones had a total income of $6700. His deductions totaled $500, and he could claim three exemptions of $600 each. He computed his tax according to the rates given in Figure 13–4.

What to Do	How to Do It
(1) Find the net taxable income: subtract deductions and exemptions from the total income.	$6700 − $500 = $6200 3 × $600 = $1800 $6200 − $1800 = $4400, taxable income
(2) Find the tax rate, and apply it to the net taxable income.	Tax rate: $840 plus 26% of excess over $4000 $4400 − $4000 = $400 .26 × $400 = $104 $840 + $104 = $944, tax

PROBLEMS

In solving these problems, use the tax rates given in Figure 13–4, page 471. Allow $600 for each exemption.

1. Mr. McKay had a total income of $5400. Since he saved money by doing so, he took the standard deduction of 10 per cent of his income, and claimed four exemptions. What income tax did he pay?

2. Miss Smith had a total income of $3300 one year. As her deductions amounted to $600, she chose to compute her tax rather than to use the tax table. She claimed only her personal exemption. What tax did she pay?

3. Mr. Anderson had a net taxable income of $7300 in a year in which the tax rate schedule was that given in Figure 13–4. What tax did he pay?

4. One year Mr. Weeks had a total income of $12,540. His contributions amounted to $1000 and his deductible taxes came to $1280. He had no other deductible expenses, but he contributed more than half the support of his sister. He was unmarried. He computed his tax according to the schedule in Figure 13–4. What income tax did he pay?

5. Mr. Skidmore had a total income of $15,000. He was able to claim three dependents, and his allowable deductions amounted to $2000. What income tax did he pay?

"There's a bright boy in my class who could help me with this tax return — if I knew how to ask him."

What You Have Learned in This Chapter

1. To compute government revenue (local, state, and Federal) obtained from various sources
2. To compute the costs of various government services
3. To determine exemptions for income tax purposes
4. To figure deductions from your income for tax purposes
5. To determine your income tax by using a tax table and by computation
6. To decide which form of income tax return a person should choose to use
7. To understand the following terms used in connection with government finances: *sinking fund, borrowing capacity, internal revenue, customs, exemption, dependent, withholding receipt, deduction, net taxable income*

Review Test on What Your Taxes Buy

1. One year a state spent $50,976,000. The money was divided as follows:

Debt service	4.7%
Highway maintenance	6.3%
Public welfare	.5%
Schools	12.5%
Operating expenses	15.2%
Capital outlay	4.0%
Aid to other governments	56.8%

How much money was spent for each item?

2. One year the Federal government had total receipts of $44,703 million. Internal revenue receipts were $39,380 million, of which $29,305 million came from income taxes.

a. What per cent of the total receipts came from internal revenue sources?

b. What per cent of the total receipts came from income taxes?

3. Mrs. Colley's total income was $3375. Her deductions were as follows:

Contributions	$150
Interest payments	160
Loss by theft	250
Deductible taxes	273

Should Mrs. Colley take the standard deduction of 10 per cent and use the tax table to find her income tax, or should she itemize her deductions and compute her tax? Explain your answer.

4. In a year in which Mr. Burns' monthly salary was $400, he had other income totaling $375. When he made out his income tax return, he reported deductions of $505 and claimed three exemptions. (Each exemption represented $600.)

a. What was Mr. Burns' total annual income?

b. What was his net taxable income?

5. Mr. Standor's net taxable income was $8280. Use the tax table on page 471 to find his tax.

How do you rate?	Excellent	Good	Fair	Poor
	5	4	3	2 or less

Check-Up Tests on Computation

These tests are matched with the tests at the ends of Units Two and Three. By now you should make no mistakes at all in computation, but should be 100 per cent accurate.

TEST ON WHOLE NUMBERS

Find these sums:

1)	2)	3)	4)	5)
50	392	17	5028	805
75	6040	908	84	120
269	581	3036	47	14
614	84	47	428	69
358	70	25	136	803

6)	7)	8)	9)	10)
906	917	604	50	271
5019	595	31	262	51
925	2036	203	269	170
58	39	770	306	95
14	25	92	58	469

11)	12)	13)	14)	15)
503	139	905	916	5028
42	786	17	606	97
392	258	714	25	847
81	25	51	940	36
681	47	803	14	136

16)	17)	18)	19)	20)
704	71	92	93	139
828	364	353	39	373
703	570	481	492	258
62	403	92	973	17
92	69	570	681	47

Find these differences:

21) 71,094 − 59,164

22) 81,309 − 26,985

23) 71,309 − 30,879

24) 34,491 − 25,914

25) 47,053 − 31,092

26) 87,976 − 35,147

27) 83,439 − 53,087

28) 79,021 − 78,496

29) 92,387 − 21,649

30) 72,360 − 64,082

31) 85,761 − 60,843

32) 42,131 − 18,435

33) 57,642 − 20,395

34) 59,472 − 10,837

35) 87,273 − 76,094

36) 251,659 − 72,568

37) 705,606 − 51,732

38) 585,348 − 90,162

39) 267,936 − 81,470

40) 351,529 − 57,263

Find these products:

41) 89 × 40

42) 50 × 57

43) 203 × 40

44) 6248 × 57

45) 72 × 86

46) 20 × 93

47) 18 × 39

48) 13 × 75

49) 9056 × 12

50) 17 × 40

51) 456 × 40

52) $\begin{array}{r}904\\ \underline{86}\end{array}$ **53)** $\begin{array}{r}97\\ \underline{75}\end{array}$ **54)** $\begin{array}{r}56\\ \underline{39}\end{array}$ **55)** $\begin{array}{r}49\\ \underline{93}\end{array}$

56) $\begin{array}{r}73\\ \underline{93}\end{array}$ **57)** $\begin{array}{r}347\\ \underline{21}\end{array}$ **58)** $\begin{array}{r}358\\ \underline{68}\end{array}$

59) $\begin{array}{r}16\\ \underline{68}\end{array}$ **60)** $\begin{array}{r}182\\ \underline{12}\end{array}$

Find the following quotients:

61) $18\overline{)545}$

62) $57\overline{)855}$

63) $57\overline{)1715}$

64) $75\overline{)6344}$

65) $18\overline{)1098}$

66) $81\overline{)2401}$

67) $57\overline{)3953}$

68) $81\overline{)6318}$

69) $75\overline{)5400}$

70) $34\overline{)2108}$

71) $81\overline{)4374}$

72) $43\overline{)3249}$

73) $60\overline{)16740}$

74) $29\overline{)26448}$

75) $92\overline{)76360}$

76) $34\overline{)11866}$

77) $60\overline{)18930}$

78) $43\overline{)34451}$

79) $29\overline{)135053}$

80) $60\overline{)482760}$

How do you rate?	Excellent	Good	Fair	Poor
	80	78–79	75–77	74 or less

TEST ON COMMON FRACTIONS

Give each sum in its lowest terms:

1) $\frac{1}{3} + \frac{1}{3}$

2) $\frac{3}{16} + \frac{1}{16}$

3) $\frac{5}{8} + \frac{1}{8}$

4) $\frac{7}{10} + \frac{3}{10}$

5) $\frac{3}{5} + \frac{4}{5}$

6) $\frac{5}{8} + \frac{7}{8}$

7) $6\frac{1}{8} + 3\frac{1}{8}$

8) $6\frac{7}{16} + 4\frac{1}{16}$

9) $\begin{array}{r} 7\frac{3}{5} \\ \underline{4} \end{array}$

10) $\begin{array}{r} \frac{9}{10} \\ \underline{\frac{2}{5}} \end{array}$

11) $\begin{array}{r} \frac{1}{2} \\ \underline{\frac{7}{8}} \end{array}$

12) $\begin{array}{r} \frac{11}{16} \\ \underline{\frac{3}{4}} \end{array}$

13) $\begin{array}{r} 14\frac{11}{12} \\ \underline{8\frac{5}{6}} \end{array}$

14) $\begin{array}{r} 5\frac{9}{10} \\ \underline{9\frac{3}{5}} \end{array}$

15) $\begin{array}{r} \frac{3}{4} \\ \underline{\frac{1}{3}} \end{array}$

16) $\begin{array}{r} \frac{4}{5} \\ \underline{\frac{3}{4}} \end{array}$

17) $\begin{array}{r} 6\frac{1}{3} \\ \underline{12\frac{3}{5}} \end{array}$

18) $\begin{array}{r} 13\frac{5}{6} \\ \underline{6\frac{4}{5}} \end{array}$

19) $\begin{array}{r} 15\frac{2}{3} \\ \underline{7\frac{1}{2}} \end{array}$

20) $\begin{array}{r} 18\frac{7}{8} \\ \underline{6\frac{1}{6}} \end{array}$

Give each difference in its lowest terms.

21) $\frac{3}{5} - \frac{1}{5}$

22) $\frac{3}{10} - \frac{1}{10}$

23) $\frac{7}{8} - \frac{5}{8}$

24) $7\frac{5}{6} - 3\frac{1}{6}$

25) $16\frac{7}{10} - 6\frac{3}{10}$

26) $12\frac{9}{16} - 8$

27) $6\frac{3}{8} - \frac{1}{8}$

28) $5 - \frac{3}{5}$

29) $\begin{array}{r} 11 \\ \underline{8\frac{1}{5}} \end{array}$

30) $\begin{array}{r} 10\frac{2}{5} \\ \underline{7\frac{4}{5}} \end{array}$

31) $\begin{array}{r} 11\frac{1}{6} \\ \underline{6\frac{5}{6}} \end{array}$

32) $\begin{array}{r} \frac{2}{3} \\ \underline{\frac{7}{12}} \end{array}$

33) $\begin{array}{r} \frac{5}{6} \\ \underline{\frac{1}{2}} \end{array}$

34) $\begin{array}{r} 22\frac{7}{8} \\ \underline{13\frac{1}{4}} \end{array}$

35) $\begin{array}{r} 20\frac{1}{6} \\ \underline{9\frac{1}{3}} \end{array}$

36) $\begin{array}{r} 20\frac{1}{10} \\ \underline{14\frac{3}{5}} \end{array}$

37) $\begin{array}{r} 12\frac{1}{2} \\ \underline{5\frac{2}{3}} \end{array}$

38) $\begin{array}{r} 29\frac{1}{3} \\ \underline{14\frac{3}{4}} \end{array}$

39) $\begin{array}{r} 18\frac{2}{5} \\ \underline{12\frac{3}{4}} \end{array}$

40) $\begin{array}{r} 25\frac{1}{8} \\ \underline{16\frac{1}{2}} \end{array}$

Give each product in its lowest terms:

41) $\frac{1}{4}$ of 48

42) $\frac{1}{8}$ of \$3.20

43) $\frac{1}{5}$ of 135

44) $\frac{5}{6}$ of 72

45) $\frac{4}{5}$ of 4

46) $\frac{5}{8}$ of 70

47) $21 \times \frac{3}{4}$

48) $\frac{3}{5} \times \frac{9}{10}$

49) $\frac{5}{8} \times \frac{4}{5}$

50) $\frac{5}{8} \times \frac{3}{10}$

51) $32 \times 1\frac{1}{4}$

52) $160 \times 3\frac{7}{8}$

53) $3\frac{1}{4} \times \frac{1}{4}$

54) $5\frac{2}{3} \times 9$

55) $21\frac{7}{8} \times 32$

56) $1\frac{3}{10} \times 3\frac{1}{3}$

57) $3\frac{1}{2} \times 4\frac{1}{2}$

58) $4\frac{1}{3} \times 1\frac{1}{2}$

59) $2\frac{3}{8} \times \frac{4}{5} \times 1\frac{2}{3}$

60) $2\frac{1}{8} \times 1\frac{3}{5} \times 1\frac{1}{3}$

Give each quotient in its lowest terms:

61) $4 \div \frac{1}{2}$

62) $5 \div \frac{2}{5}$

63) $6 \div \frac{3}{8}$

64) $\frac{1}{3} \div \frac{1}{3}$

65) $\frac{1}{4} \div \frac{1}{5}$

66) $\frac{4}{5} \div \frac{2}{5}$

67) $\frac{3}{8} \div \frac{5}{6}$

68) $\frac{4}{5} \div 12$

69) $\frac{5}{6} \div 20$

70) $\frac{1}{6} \div 12$

71) $1\frac{3}{5} \div 4$

72) $7\frac{1}{2} \div \frac{3}{8}$

73) $7\frac{1}{6} \div 3$

74) $30 \div 1\frac{1}{4}$

75) $\frac{9}{10} \div 6\frac{1}{4}$

76) $9 \div 4\frac{3}{4}$

77) $\frac{3}{4} \div 3\frac{3}{5}$

78) $4\frac{1}{4} \div 1\frac{2}{5}$

79) $2\frac{5}{6} \div 3\frac{7}{8}$

80) $4\frac{5}{6} \div 1\frac{1}{6}$

How do you rate?	Excellent	Good	Fair	Poor
	80	78–79	75–77	74 or less

TEST ON DECIMAL FRACTIONS

Add each of the following groups of decimal fractions:

1) .3, .1, .5
2) .8, .7, .5
3) .23, .24, .45
4) .27, .18, .46
5) .03, .58, .24
6) .32, .67, .16, .89
7) .30, .85, .20, .57
8) .79, .95, .87, .65
9) .436, .062, .008
10) .729, .656, .435
11) 2.7, 7.4, 1.8
12) 9.2, 4.3, 5.8
13) 3.27, .36, 7.95
14) 8.34, 9.62, 87.05
15) 9, 4.7, 3.8
16) 9.8, 8.6, 5.2
17) 93.48, 3.57, 72.79
18) 10, .05, 46.75
19) 8.473, .739, 6.021
20) .807, 5.256, .774

Subtract the smaller number from the larger in each pair of numbers:

21) .2, .3
22) .35, .46
23) .63, .62
24) .98, .89
25) .45, .39
26) 1.5, 2.5
27) 26.4, 8.4
28) 44.47, 36.29
29) 9.9, 8
30) 7, 9.2
31) 64, 83.8
32) 2.9, 26
33) 7, .06
34) 8.034, 8.304
35) 25, 20.25
36) 100, 98.5
37) 37.5, 50
38) .03, .053
39) .0221, .0201
40) 1.258, .417

Multiply:

41) $\begin{array}{r} .3 \\ \underline{5} \end{array}$ **42)** $\begin{array}{r} 36 \\ \underline{.4} \end{array}$ **43)** $\begin{array}{r} .12 \\ \underline{7} \end{array}$ **44)** $\begin{array}{r} 48 \\ \underline{.32} \end{array}$

45) $\begin{array}{r} .735 \\ \underline{2} \end{array}$ 46) $\begin{array}{r} 496 \\ \underline{.003} \end{array}$ 47) $\begin{array}{r} .4 \\ \underline{.6} \end{array}$ 48) $\begin{array}{r} .48 \\ \underline{.7} \end{array}$

49) $\begin{array}{r} .09 \\ \underline{.6} \end{array}$ 50) $\begin{array}{r} .28 \\ \underline{.5} \end{array}$ 51) $\begin{array}{r} .08 \\ \underline{.09} \end{array}$

52) $\begin{array}{r} 5.4 \\ \underline{3.2} \end{array}$ 53) $\begin{array}{r} .75 \\ \underline{6.3} \end{array}$

54) $\begin{array}{r} 600 \\ \underline{.04} \end{array}$ 55) $\begin{array}{r} 270 \\ \underline{.025} \end{array}$ 56) $\begin{array}{r} .048 \\ \underline{360} \end{array}$

57) $\begin{array}{r} 108.2 \\ \underline{.43} \end{array}$ 58) $\begin{array}{r} 7.93 \\ \underline{5.2} \end{array}$ 59) $\begin{array}{r} 19.95 \\ \underline{.25} \end{array}$ 60) $\begin{array}{r} 249.75 \\ \underline{.20} \end{array}$

Divide:

61) $2\overline{).6}$	**68)** $38\overline{)1.33}$	**75)** $.08\overline{).496}$
62) $3\overline{).51}$	**69)** $8\overline{)7}$	**76)** $2.3\overline{)20.01}$
63) $9\overline{).036}$	**70)** $15\overline{)12}$	**77)** $21.5\overline{)96.75}$
64) $4\overline{)13.6}$	**71)** $10\overline{)4.6}$	**78)** $6.25\overline{)75}$
65) $23\overline{).736}$	**72)** $100\overline{)2.7}$	**79)** $3.7\overline{)17.28}$
66) $16\overline{)6.56}$	**73)** $1000\overline{)56.3}$	**80)** $4.52\overline{)24.28}$
67) $43\overline{)352.6}$	**74)** $.6\overline{).72}$	

How do you rate?	Excellent	Good	Fair	Poor
	80	78–79	75–77	74 or less

TEST ON PER CENTS

1) What per cent of 84 is 63?
2) \$9.60 is what per cent of \$16.00?
3) 90 is what per cent of 75?
4) \$200 is what per cent of \$700?
5) What per cent of 60 is 15?
6) \$216 is what per cent of \$240?
7) .5 is what per cent of 125?
8) 16 is what per cent of 4?
9) 9 is what per cent of 5?
10) $\frac{1}{8}$ is what per cent of $\frac{1}{4}$?
11) What per cent of 64 inches is 48 inches?
12) What per cent of \$50 is \$70?
13) \$.04 is what per cent of \$.64?
14) \$5.00 is what per cent of \$7.50?
15) 9 is what per cent less than 12?
16) 25 is what per cent more than 20?
17) 589 is what per cent less than 620?
18) 85 is what per cent increase over 58?
19) \$180 is what per cent decrease from \$270?
20) 970.8 is what per cent increase over 865?

How do you rate?	Excellent	Good	Fair	Poor
	20	19	17–18	16 or less

UNIT FIVE

Some Mathematical Tools

CHAPTER 14

MONKMEYER

And so you see how
Mathematics can throw light
on various subjects
which many people discuss
glibly and carelessly
since they have never been trained
to examine ideas
With that METICULOUS CARE
with which a mathematician works.

H. G. and L. R. Lieber, *The Education of T. C. Mits*, W. W. Norton, 1944

STATISTICS

FACTS EXPRESSED IN NUMBERS

WHEN FACTS can be expressed in numbers, they are called *statistics.* For example, the facts that the land area of the United States is 2,977,128 square miles and that the inland-water area is 45,259 square miles are statistics.

Statistics are most often reported in tables and graphs. You can scarcely read a newspaper or magazine without coming upon tables or graphs of statistics. Therefore you should know how to read and interpret them. You should also know how to present statistics accurately, clearly, and interestingly.

Statistical Tables

Statistics are reported in the form of tables chiefly because in that way a large amount of information can be put in a small amount of space. For example, Table 24, page 488, takes much less space than the same facts would if you were to write them all in sentences.

Reading Tables

The first thing to notice about any table is its title. The title of a table should tell *exactly* what the table is about.

Notice the title of Table 24. First, it tells that the table is about the popular vote for President of the United States. Second, it tells how this vote is reported: by chief political parties. Third, it tells for what years the vote is reported: 1940 to 1952.

Table 24. POPULAR VOTE FOR PRESIDENT OF THE UNITED STATES, BY CHIEF POLITICAL PARTIES: 1940 TO 1952

Year	*Democratic*	*Republican*
1940	27,243,466	22,304,755
1944	25,602,505	22,006,278
1948	24,105,812	21,970,065
1952	27,314,992	33,936,252

The title of Table 24 would be incorrect if any part of it were omitted. Suppose, for example, that the phrase "by chief political parties" had been left out. Then you might expect the vote to be reported according to all the political parties – Progressive, Socialist, Farmer-Labor, Prohibition, and so on. Or you might expect the vote to be reported according to the names of the presidential candidates Roosevelt, Dewey, Truman, Eisenhower, and others. If the title had not told what years were included in the report, you might expect to have the table cover all presidential elections ever held. Because the title is correctly stated, you know just what to expect from the table.

When you are reading a table for general information on a topic, you should read the rows from left to right. For example, the first row of Table 24 reads: In the 1940 presidential election, the Democratic party polled 27,243,466 votes, and the Republican party polled 22,304,755 votes.

You can read a table to find some particular fact or relationship. Suppose you needed to know how many votes the

Republican presidential candidate received in 1944. You would look down the column headed *Year* until you came to *1944;* then you would look along that line until you came to the column headed *Republican.* There you would find your information: 22,006,278. Or suppose you wanted to know how the Democratic popular vote changed from one presidential election to the next. You would look down the column headed *Democratic,* noting the change from one election year to the next.

PROBLEMS

1. Answer questions *a* to *g* by referring to this table:

ACCIDENTAL DEATHS IN THE UNITED STATES, BY CHIEF TYPES OF ACCIDENT: 1951 AND 1952

Type of Accident	1951	1952
Firearms	2,150	2,350
Falls	21,200	20,400
Burns	6,600	6,700
Motor vehicle	37,300	38,000
Drowning	6,500	6,800
Railroad	3,600	3,200
Poison gas	1,650	1,500
Poison (except gas)	1,550	1,500

a. What three facts does the title of the table tell?

b. Are all the accidental deaths in the United States in 1951 and 1952 reported in the table?

c. What information does the first row of the table give you?

d. How many accidental deaths from drowning occurred in the United States in 1951?

e. Which type of accident caused the greatest number of accidental deaths in the United States in 1952?

f. Which types of accidents caused fewer deaths in the United States in 1952 than in 1951?

g. Which types of accidents caused more deaths in the United States in 1952 than in 1951?

2. Answer questions *a* to *f* about the table that follows:

NUMBER OF DOMESTIC ANIMALS ON FARMS IN THE UNITED STATES: 1915 AND 1953		
Animals	**1915**	**1953**
Horses and Mules	26,493,000	5,636,000
Cattle	63,849,000	93,696,000
Sheep	40,513,000	27,857,000
Swine	56,600,000	54,632,000
Milk Cows	20,270,000	23,996,000

a. How many horses and mules were there on the farms in 1915?

b. How many fewer horses and mules were there on American farms in 1953 than in 1915?

c. How many fewer milk cows were there on American farms in 1915 than in 1953?

d. What change occurred in the number of cattle on farms in the United States between 1915 and 1953?

e. What information does the table give about sheep?

f. What facts can you learn about swine from the table?

3. Answer questions *a* to *f* about the following table reporting types of expenditure:

HOW THE CONSUMER IN THE UNITED STATES SPENT HIS MONEY IN THE YEARS 1901, 1918–1919, 1934 1936; AND IN THE MONTH OF MARCH 1951				
Type of Expenditure	**1901**	**1918–1919**	**1934–1936**	**March 1951**
Food	45%	38%	34%	35%
Clothing	14%	17%	11%	13%
Rent	14%	14%	17%	11%
Fuel	6%	5%	7%	3%
Other	21%	26%	31%	38%

a. What per cent of his income did the average or typical

consumer in the United States spend for food in March 1951?

b. What per cent of his income did the consumer spend for food in 1901?

c. During which period of time did the consumer spend the greatest per cent of his income for clothing?

d. What facts does the table show about the per cents spent for rent during each of the four periods?

e. How does the total per cent spent for necessities (food, clothing, rent, and fuel) in March 1951 compare with the total per cent spent for these items in 1901?

WIDE WORLD

This young man makes a business of collecting and organizing facts about young people's buying habits, likes, dislikes, and opinions.

f. Does this table show you that the average family in the United States spent *more money* for rent each month during the years 1934–36 than in March 1951?

4. Suppose you came upon a table with this title: IMPORTS AND EXPORTS OF UNITED STATES PRODUCTS, IN THOUSANDS OF TONS: 1950 TO 1955. Tell whether or not you would be able to learn the following facts from the table:

a. The number of tons imported at Boston, Massachusetts, in 1950.

b. The number of tons exported from Seattle, Washington, in 1949.

c. The value of the imports of San Francisco, California, in 1952.

d. The tonnage received at Detroit, Michigan, in 1954.

e. The total tonnage exported from the United States in 1953.

5. Assume that you are looking for information about births in the United States. You find a table with this title: NUMBER OF BABIES BORN IN THE UNITED STATES, BY SEX: 1945 TO 1954.

a. Would the table give you the number of girls born in 1952?

b. Would the table give the number of boys that were born in the same year you were born?

c. Could you find how many babies were born in the United States in 1953?

d. Could you find out whether more boys or more girls were born in 1942?

e. What would you have to do to find what per cent of the babies born in 1951 were boys?

f. Could you find how the total birth rate changed from year to year from 1945 to 1954?

g. What would you do to find the average number of babies born per year during the time from 1945 to 1954?

Making Statistical Tables

When you make a statistical table, there are three points to watch: (1) that your facts are presented in an orderly fashion; (2) that the headings of the columns are appropriate; (3) that the title is exact and complete.

Suppose you were making a report on the sale of tickets for a school event. You might report the number by classes, or by home rooms, or by clubs. In any case, you would be careful to head the column correctly, and to include the information in the title of the table. If tickets were of two kinds, student and non-student, you would want to report this breakdown. Again you would be careful to indicate the breakdown in the column headings and in the title of the table. Your report might look like Table 25.

Table 25. NUMBER OF STUDENT AND NON-STUDENT TICKETS SOLD FOR *As You Like It*, BY CLASSES

Class	*Student Tickets*	*Non-Student Tickets*
Freshman	65	54
Sophomore	58	66
Junior	59	61
Senior	47	72

PROBLEMS

1. Leadville High School has an enrollment of 203 in the ninth grade, 187 in the tenth grade, 197 in the eleventh grade, and 162 in the twelfth grade. Make a table of these facts.

2. Write a corrected title for the table that follows.

FIRES IN NEW YORK CITY		
Year	*Number*	*Amount of Loss*
1949	44,407	$20,249,930
1950	44,370	19,512,870
1951	44,040	21,082,530
1952	52,741	26,948,062

3. Copy this table supplying the headings for the columns:

NATIONAL INTERSCHOLASTIC RELAY RECORDS IN 1953	
440 yd.	42.0
880 yd.	1 : 27.6
1 mi.	3 : 21.4
2 mi.	8 : 05.5

4. Recently a traffic survey was made in thirty-five large cities of the United States to find the purposes for which people made trips in their automobiles. The results of this survey showed that 59 per cent of the trips were for work or business; 18 per cent for social purposes or for recreation; 15 per cent for shopping; and 8 per cent for other purposes. Make a table reporting these facts.

5. In 1949, 134 million bushels of apples were produced in the United States; in 1950, 123 million bushels; and in 1951, only 113 million bushels. In the same years, production of peaches was 75 million bushels, 53 million bushels, and 70 million bushels, respectively. Make a table presenting these facts.

a. Would the table give you the number of girls born in 1952?

b. Would the table give the number of boys that were born in the same year you were born?

c. Could you find how many babies were born in the United States in 1953?

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Graphs

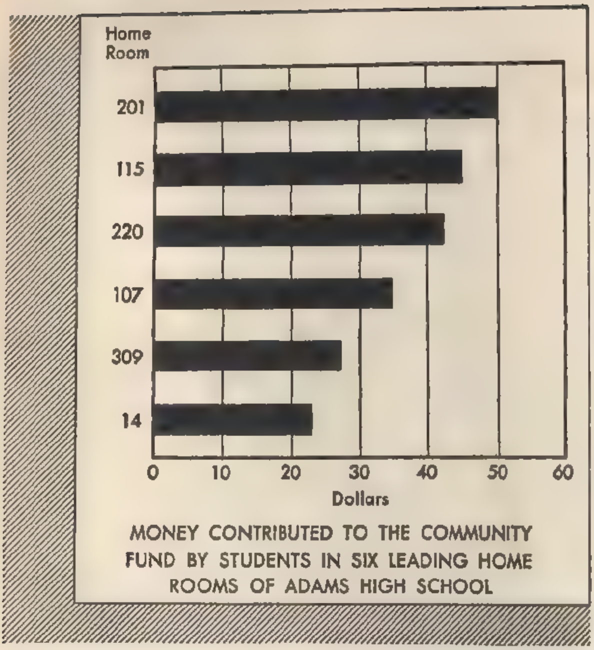


Figure 14–1

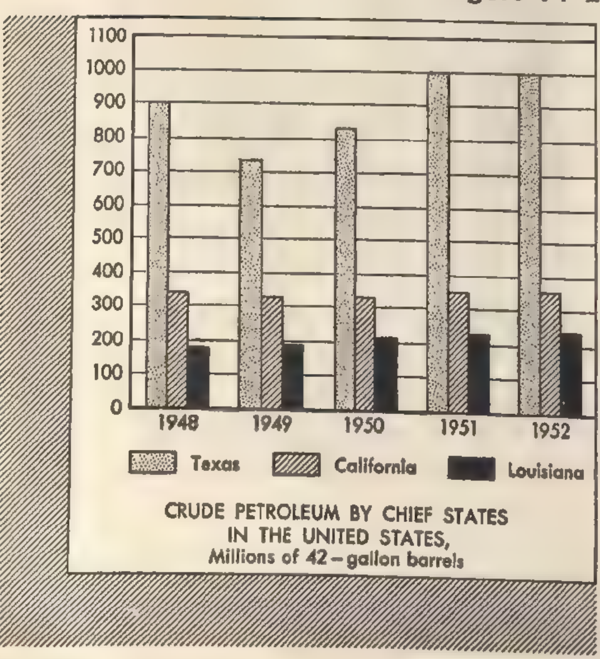
Facts which can be presented in statistical tables may be shown in the form of graphs. A graph often shows the relationship between facts in a manner which can be more easily seen and understood than a table.

The graph in Figure 14–1 shows you at a glance, which room collected the most money and how well each other room did. Like a statistical table, a graph must have a complete title.

Other kinds of graphs are line graphs, circle graphs, rectangular graphs, and picture graphs. In picture graphs, the number or size of the pictures shows the desired relationship.

Bar Graphs

Figure 14–2



You will notice that the vertical line in Figure 14–1 shows room numbers. This is the *vertical reference line* or *axis*. The horizontal bars show how much money was collected by each room. Below is the *horizontal reference line* or *axis*. The graph must show what each reference line means.

Bars may be arranged vertically as shown in Figure 14–2. In this graph you will notice that not only the oil production of the three states may be compared, but also their production during

the five years. The bars are shaded to distinguish between the states, and the meaning of the shading is explained. The meaning of the shading, the correct labeling of the reference lines, and the complete title are all necessary to make the graph clear to anyone who examines it.

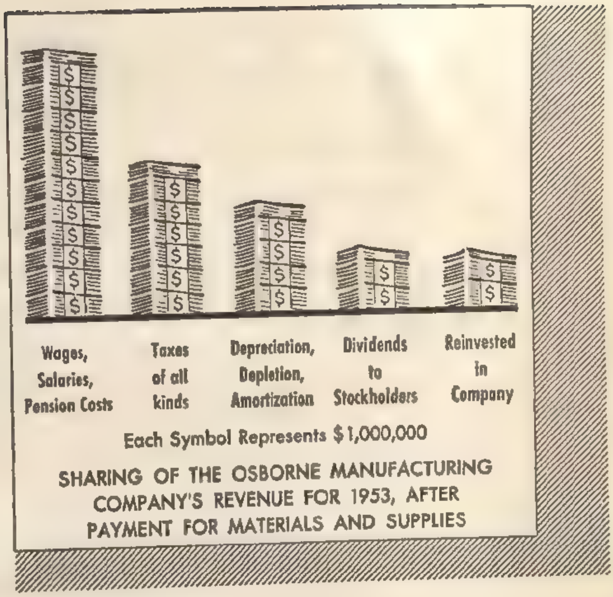
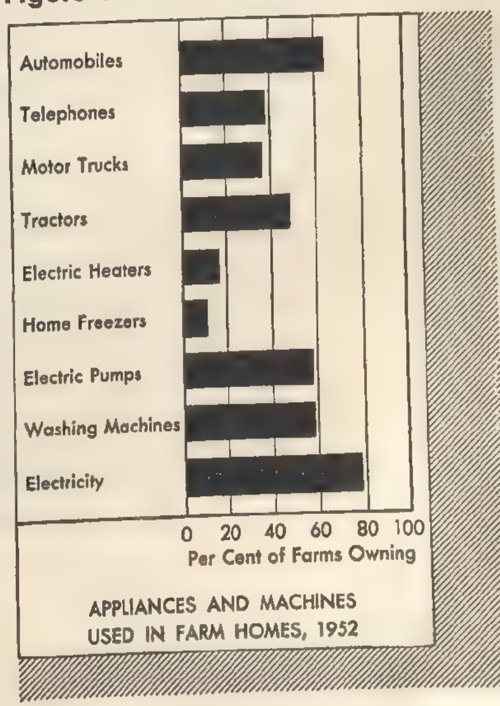


Figure 14–3

A picture graph may show the same facts as those shown in a bar graph. However, the relation between the facts is pictured by means of symbols, as in Figure 14–3. Notice that each symbol is the same size, and that each bundle of bills represents a million dollars. The graph must make clear just what each symbol represents. Each symbol pictures persons or things of the type referred to in the statistics. The symbols used may be people, automobiles, or any other objects. Sometimes a long and a short symbol, such as a long and a short railroad track, may be placed side by side; then the reader can compare the number of miles of railroad. When this is done, care must be taken that the relation between the size of the objects is actually the same as the relation between the number of things. Only the height or the length should be different, for if

Figure 14–4



a solid object like a can keeps the same shape and is made twice as high (*and* long *and* thick), it becomes not twice but eight times as bulky! That, in a pictogram, would deceive the reader.

In making a bar graph such as shown in Figure 14–4, you must plan your work carefully before you begin. This graph has nine bars and ten spaces between, above, and below the bars. In addition you must make room for the reference lines and the title.

Always make each bar the same width and have the same space between bars. When dealing with large numbers, round off the numbers first and then plan the graph so that the longest bar will fit into it.

PROBLEMS

1. Answer the questions which follow, referring to Figure 14–1.

a. Does this graph tell how much money was collected in every homeroom of the school?

b. Does the graph tell the total amount of money collected for the community drive in the school?

c. What homerooms does the graph tell about, and how much money was collected in each homeroom?

d. What is the title of this graph?

e. What do the horizontal and vertical reference lines tell you?

f. Can you find, using the information given in the graph, the average amount of money given per pupil?

2. Answer the following questions regarding the graph in Figure 14–2:

a. State three items which may be compared in this graph.

b. Which state produced the most oil each year?

c. How much did the oil production increase in each state from 1948 to 1952?

d. Tell which of the following facts can be determined from the graph and which cannot:

(1) The number of barrels of oil produced in Texas in 1951.

(2) How much more oil was produced in Texas in 1952 than in California.

(3) The total number of barrels of oil produced in the United States in 1951.

(4) Which of the three states had the greatest increase in the number of barrels of oil produced.

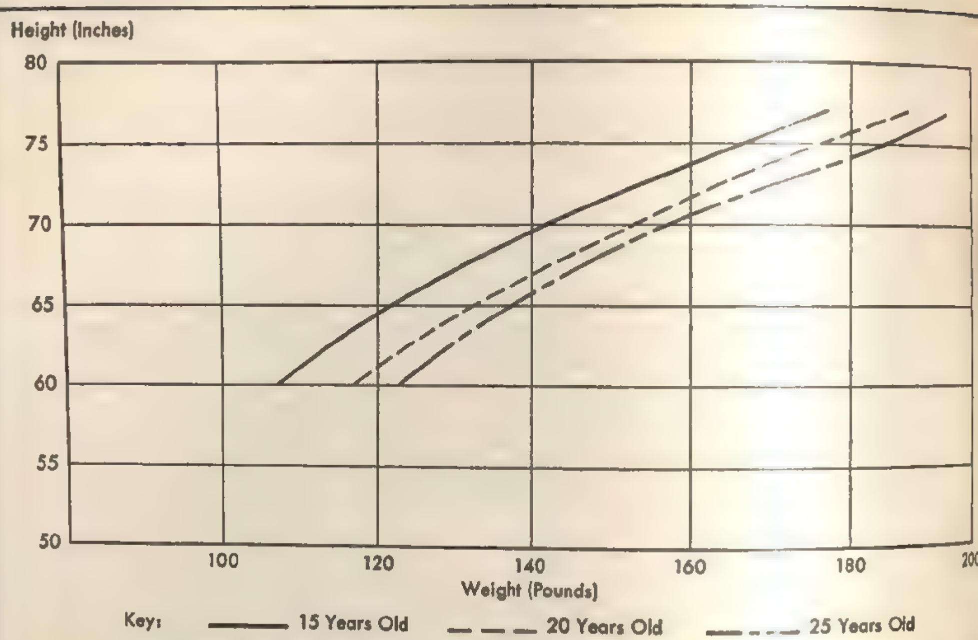
3. Using the facts listed below, make a bar graph showing the taxes on a popular-priced automobile in 1952. Round off each amount to the nearest dollar.

Kind of Tax	*Amount of Tax*
Materials and Transportation	\$150.00
Manufacturers' Income	149.35
Federal Excise	146.00
Dealer's	66.65
Sales	57.85
License and Title	12.75

4. The information below shows the capital investment, per production worker in manufacturing industries, in the United States for the period 1925 to 1951. Arrange the information in the form of a bar graph.

Year	*Amount of Investment per Worker* (In \$1000's)
1925	7.2
1928	7.5
1931	8.6
1934	7.9
1937	5.5
1940	6.0
1943	5.3
1946	7.0
1949	9.5
1952	11.5

5. Recently a survey was made to find how the average motorist spent his money while on vacation. The results show that of each dollar spent, 21 cents was for transportation; 29 cents for meals; 7 cents for theater and other amusements; 20 cents for lodgings; 18 cents for retail purchases; and 5 cents for admission to travel attractions. Using pictures of nickels, make a picture graph showing these facts.



AVERAGE WEIGHT OF YOUNG AMERICAN MEN 60 TO 77 INCHES TALL AT 15, 20, AND 25 YEARS OF AGE

Figure 14–5

Line Graphs

Figure 14–5 is a sample line graph. The title tells what information it presents: the average weight of young American men from 60 inches to 77 inches in height at 15, 20, and 25 years of age. The vertical axis (reference line) is marked to show height in inches; the horizontal axis is marked to show weight in pounds. The *key* indicates that the continuous line is the graph for fifteen-year-olds; the dash line is the graph for twenty-year-olds; and the dotted line is the graph for men of 25.

You can get a great deal of information from a line graph. In the left hand column on the next page are two typical questions that can be answered from Figure 14–5. In the right hand column you are told how to find the answers, and the method is diagrammed in Figure 14–6.

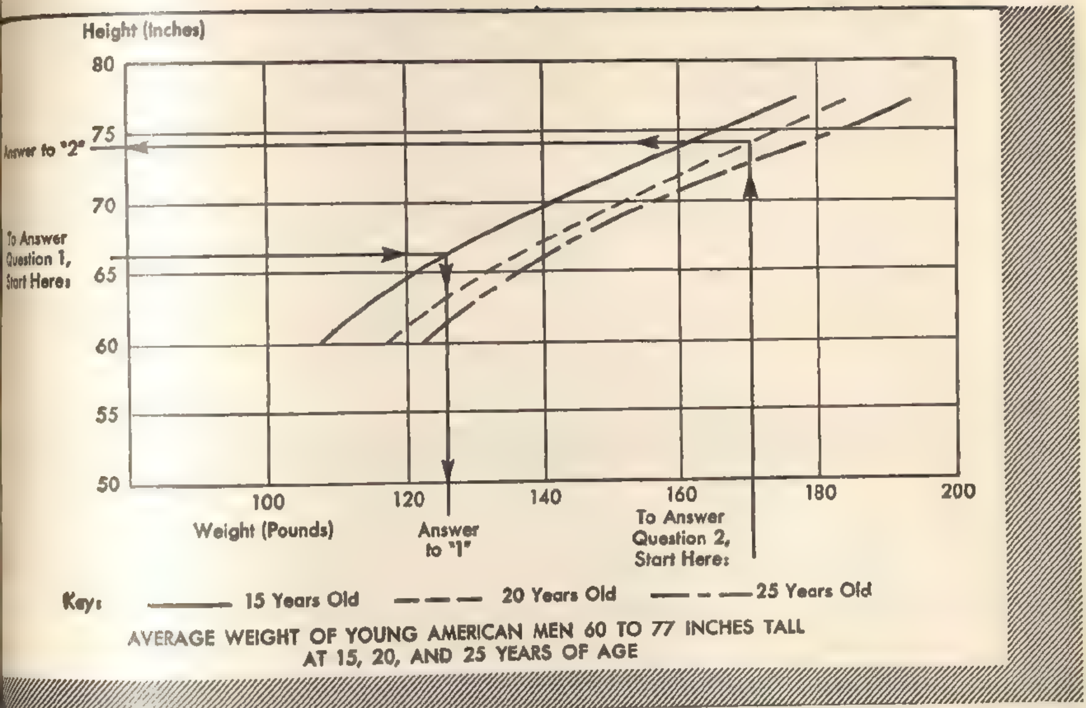


Figure 14–6

Question and Answer	*How Answer Is Found*
(1) What is the average weight of fifteen-year-old American boys who are 5 feet 6 inches (66 inches) tall? *125 pounds*	Find 66 on the vertical reference line. (See Figure 14–6.) A horizontal line has been drawn through that point. Follow it to the right until you come to the graph for fifteen-year-olds. A vertical line has been drawn through the point where they meet. Follow the vertical line downward until you come to the horizontal reference line. Estimate the weight indicated there.
(2) How tall is the average twenty-year-old American boy who weighs 170 pounds? *74 inches, or 6 feet 2 inches*	Find 170 on the horizontal reference line. (See Figure 14–6.) A vertical line passes through that point. Follow it upward to the graph for twenty-year-olds. A horizontal line passes through the point where the two meet. Follow the horizontal line to the left until it crosses the vertical reference line. Read the height indicated there.

AVERAGE WEIGHT OF FIFTEEN YEAR OLD AMERICAN BOYS 65 TO 70 INCHES TALL

Height (Inches)	Weight (Pounds)
65	122
66	126
67	130
68	134
69	138
70	142

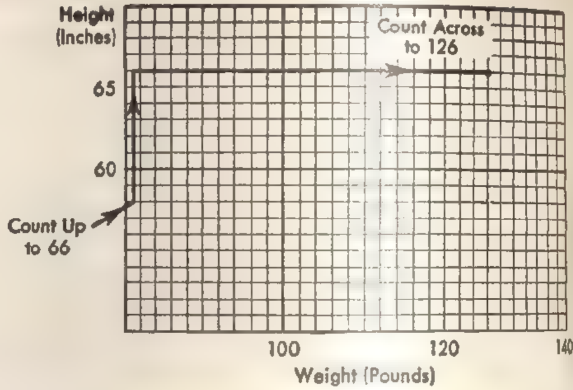


Figure 14–7

Figure 14–5 was drawn from figures in a table. After the spacing of the graph had been decided upon and the reference lines had been drawn and labeled, the points were located, or *plotted.* Figure 14–7 shows a portion of the table that was used and illustrates how one of the points was plotted. Each of the other points was plotted in the same way; that is, according to these steps:

(1) Count up the vertical reference line to the point that indicates the height.

(2) Count across the graph according to the scale on the horizontal reference line to the point that indicates the corresponding weight.

(3) Put a dot (or a cross or circle) to mark the point.

When all the points have been plotted, they are connected with straight lines. Often these short straight lines form a jagged pattern; so a graph of this sort is called a *broken-line graph.*

PROBLEMS

1. Refer to Figure 14–5, page 498, to answer the following questions:

a. On the average, what is the weight of American young men 15 years old and 6 feet tall?

b. What is the average weight of American young men of 20 who are 6 feet tall?

c. What is the average weight of American young men of 25 who are 6 feet tall?

d. What is the average height of American young men of 15 who weigh 140 pounds?

e. What is the average height of American young men of 20 who weigh 150 pounds?

f. Which of the following statements are correct, according to the graph?

(1) Tall boys 15 years old are likely to be heavier than short boys of the same age.

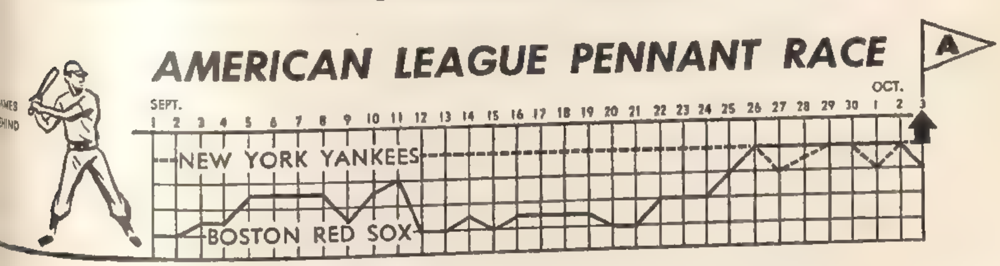
(2) Men of 25 are likely to weigh more than men of the same height who are only 20 years old.

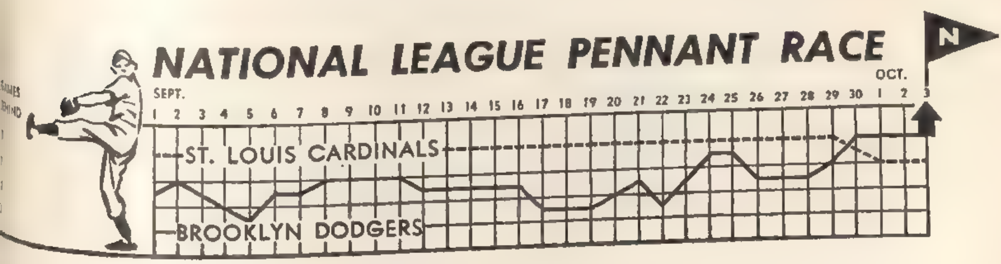
(3) No American men are shorter than 5 feet.

(4) American boys of 15 all weigh between 107 and 179 pounds.

(5) Young men of 15 and young men of 20 who are the same height differ more in average weight than young men of 20 and young men of 25 who are the same height.

2. The graph below shows the leading contenders in each major baseball league during the last few weeks of a recent season. Answer these questions by referring to it:





a. What dates are covered by the graph?

b. What was the standing of the Red Sox on September 15?

c. What was the standing of the Dodgers on September 15?

d. How many days during September did the Yankees lead the American League?

e. How many days during September did the Cardinals lead the National League?

f. What teams were leading on October 1?

g. What teams won the pennants?

3. Make a line graph showing how the speed of an automobile is related to the distance within which it can be brought to a stop. Use the facts in the following table. (Round the average stopping distance to the nearest foot.)

AVERAGE STOPPING DISTANCE OF AUTOMOBILES MOVING AT TEN TO SIXTY MILES PER HOUR

Speed (Miles per Hour)	*Average Stopping Distance (Feet)*
10	16.6
15	28.1
20	42.6
25	59.8
30	79.4
35	101.2
40	125.8
45	153.3
50	183.4
55	215.6
60	250.8

4. On Saturday, January 20, Ronald Day took temperature observations every hour from 6 A.M. to 6 P.M., using a thermometer in a shaded spot in Waterville, Ohio. He found the temperatures to be as follows: 15°, 18°, 20°, 26°, 30°, 40°, 48°, 54°, 54°, 45°, 40°, 37°, and 26°. Make a broken-line graph showing these temperatures.

5. One October the daily maximum and minimum temperatures in New York City were as follows:

Day	*Maximum*	*Minimum*	*Day*	*Maximum*	*Minimum*
1	54	45	17	71	53
2	56	46	18	67	59
3	72	48	19	63	48
4	78	55	20	57	48
5	78	61	21	64	47
6	87	62	22	68	46
7	83	67	23	71	49
8	69	52	24	77	54
9	61	49	25	69	56
10	64	54	26	70	61
11	70	56	27	74	62
12	70	54	28	74	61
13	62	48	29	75	63
14	65	45	30	79	63
15	69	52	31	80	59
16	68	51			

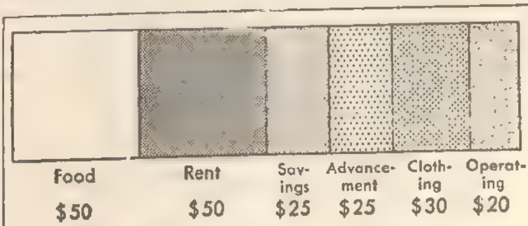
Present these statistics in the form of a line graph.

Graphs Showing Fractions or Per Cents

Some graphs are made to show the parts into which a total quantity is divided. When you read one of these graphs, you learn what the total represents from the title of the graph, and you learn what each part is from the labels on the divisions. There are no reference lines.

Figure 14–8 is a graph of this sort. The total quantity is represented by the large rectangle; from the title you learn that this quantity is $200. The unshaded part of the rectangle is just one fourth as large as the whole rectangle; it represents the $50 to be spent for food, or one fourth of the total income of $200. Each of the other parts of the large rectangle represents a certain fraction of the total income.

Figure 14–8



SUGGESTED BUDGET FOR TWO PERSONS WITH AN INCOME (AFTER TAX DEDUCTIONS) OF $200 A MONTH

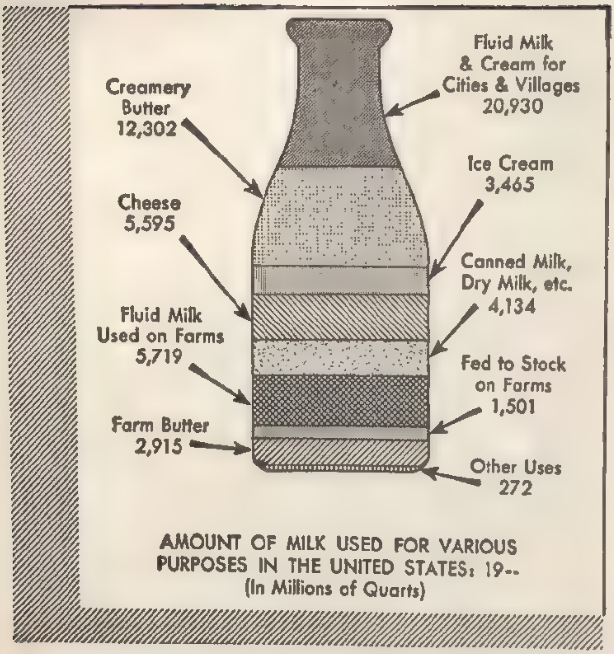
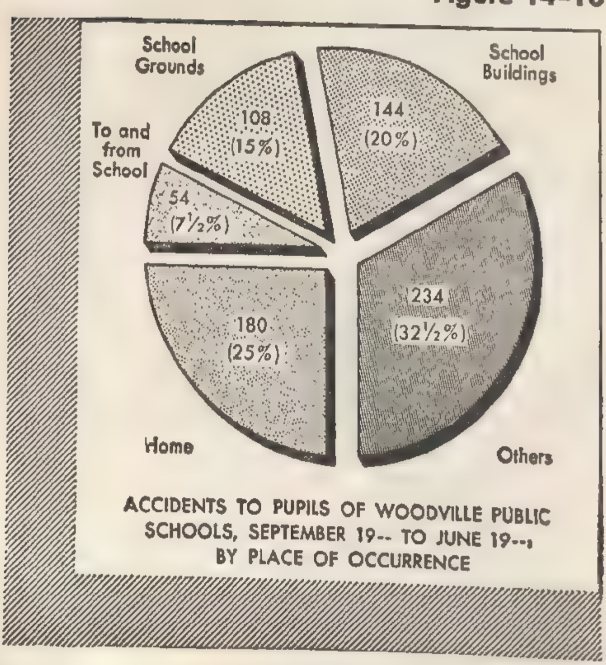


Figure 14–9

A figure of any shape may be used for a graph of this sort. In Figure 14–9 a milk bottle represents all the milk produced in the United States in a recent year. Each of the shaded portions of the bottle indicates what fraction of the total was used for a given purpose.

The most common kind of "part-whole" graph is the circle graph, such as the one in Figure 14–10. The title of this graph tells that the whole circle represents all the accidents suffered by the pupils of the Woodville Public Schools during a single school year. The labels of the divisions tell where the accidents occurred. The figures in the divisions tell how many accidents occurred in each place. As you can learn by adding the figures in the divisions of the circle, there were 720 accidents in all. Each division represents a certain fraction or a certain per cent of 720. For example, the piece representing the accidents that took place at home is $\frac{1}{4}$ or 25 per cent of the entire circle: 180 is $\frac{1}{4}$ of 720. Similarly, the piece representing the accidents that occurred in school buildings is $\frac{1}{5}$ of the circle; 144 is $\frac{1}{5}$ of 720.

Figure 14–10



To present statistics by means of a "part-whole" graph, your facts must be in the form of per cents or fractions of a whole. (Of course, you can easily calculate these per cents or fractions.) The next step is to draw a figure to represent the total amount, and then to divide it into parts corresponding to the per cents or fractions you are reporting.

In a circle graph, these parts are pie-shaped pieces. The size of each pie-shaped piece is determined by the angle it makes at the center of the circle. To make circle graphs, therefore, you must know how angles are measured.

The *unit* in which angles are measured is the degree (°). The instrument used to measure angles is the protractor. One is pictured in Figure 14–11, on page 506.

You can draw an angle of any size by using a protractor, much as you can draw a line of any length by using a ruler. However, although there is no limit to the length of a line (it can be $\frac{1}{4}$ inch in length, or it can be any number of miles), there is a limit to the size of an angle. No angle can contain more than 360 degrees; 100 per cent of a quantity corresponds to 360 degrees. So the next step in making a circle graph is to find how many degrees correspond to each per cent.

For example, if you were making a circle graph of the facts in Table 26, you would calculate 14.0 per cent of 360°, 28.7 per cent of 360°, and so on. These calculations have been indicated next to the table.

Table 26. DISTRIBUTION OF FAMILY INCOME IN THE UNITED STATES, 19—

Income	*Per Cent*	
Under $1000	14.0	$.140 \times 360 = 50.40 = 50°$
$1000–$1999	28.7	$.287 \times 360 = 103.32 = 103°$
$2000–$2999	30.7	$.307 \times 360 = 110.52 = 111°$
$3000–$4999	17.7	$.177 \times 360 = 63.72 = 64°$
Over $5000	8.9	$.089 \times 360 = 32.04 = 32°$

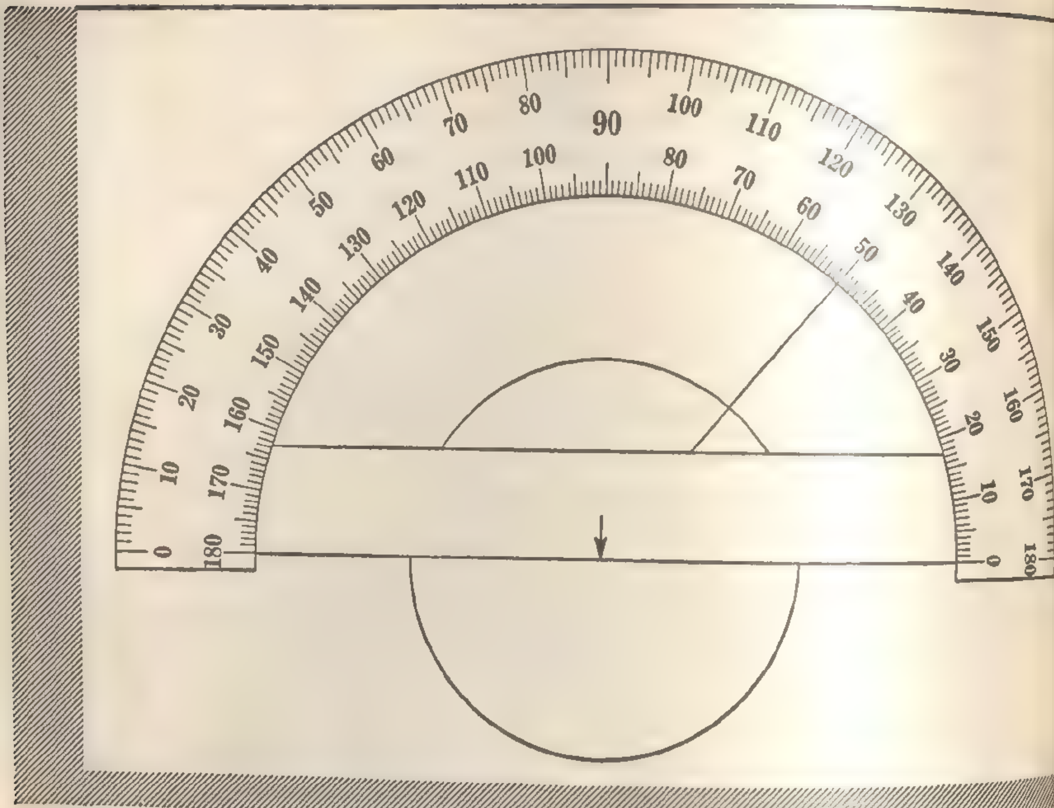


Figure 14-11

To divide your circle into pieces of the proper sizes, proceed as follows: Draw one straight line from the center of your circle to its circumference. Place your protractor on this line, in such a way that the point marked by an arrow is on the center of your circle. Find the number of degrees you need on the scale of your protractor. Place a dot on your paper as close to that number as you can. Then remove your protractor and draw a line passing through the dot from the circumference to the center of the circle. (The protractor in Figure 14–11 was put back after the angle was drawn.) Now you have one pie-shaped piece. To make the next piece, put your protractor on the line just drawn, again having the arrowhead at the center of the circle. Find the number of degrees you need for your second piece, and continue until the circle is completely divided.

In making a rectangle graph, measure the length of your rectangle, and then multiply this length by each per cent or fraction. If you were making a rectangle graph 6 inches in length from the facts in Table 26, the parts would have the following lengths:

$$.140 \times 6 = .840 = .8 \text{ in.}$$
$$.287 \times 6 = 1.722 = 1.7 \text{ in.}$$
$$.307 \times 6 = 1.842 = 1.8 \text{ in.}$$
$$.177 \times 6 = 1.062 = 1.1 \text{ in.}$$
$$.089 \times 6 = .534 = .5 \text{ in.}$$

Whether you make a rectangle graph or a circle graph, each part of the graph should be labeled. It is good practice to color or shade the parts, also. And remember that the title of a "part-whole" graph is even more important than the title of other kinds of graphs; so be sure to write a complete and accurate title.

PROBLEMS

1. According to Figure 14–8:

a. How much of a net income of $200 a month is suggested as an appropriate amount to save?

b. What per cent of the monthly net income is to be budgeted for each kind of expense?

2. Referring to Figure 14–9:

a. List the uses of milk in the United States in the order of the amount used, and next to each use write the number of quarts consumed.

b. Find out how many quarts of milk were used in all during the year reported.

3. Answer these questions by referring to Figure 14–10:

a. How many of the accidents to pupils in the Woodville Public Schools occurred on the school grounds?

b. How many more accidents occurred in school buildings than on school grounds?

c. Which of the following statements are true for the Woodville Public Schools, according to the information given in the graph?

(1) A pupil is less likely to be injured by an accident on the school grounds than in the school buildings.

(2) Twice as many accidents occur on the school grounds as in going to and from school.

(3) Most of the accidents occur at school.

(4) Almost one third of the accidents occur in unspecified places.

(5) Fewer accidents occur per hour in going to and from school than in the home.

4. Mr. Miller figured that it cost him \$480 to operate his car for a year, including an allowance of \$160 for depreciation. His insurance, license, and registration cost him \$57.60, and his garage rent was \$4 a month. His repair bills totaled \$100.80, and he spent \$19.20 on tires and tubes. The remaining expense was for gasoline and oil. Find what per cent of the total cost could be charged to each item, and make a circle graph presenting the findings.

5. Reports on accidents to students during a recent school year showed that 41 per cent of the accidents occurred in school buildings, 19 per cent occurred on school grounds, 5 per cent took place going to and from school, 12 per cent occurred at home, and 23 per cent occurred elsewhere. Present these facts in the form of a rectangle graph.

Describing Data

Everyone who collects statistics organizes them in one way or another. Your teachers, for example, collect statistics about their students (including the grades these students make on tests and assignments). Probably they keep these figures in roll books, in which the names of the students are arranged alphabetically by class periods. This arrangement is useful when teachers want to learn how well an individual student is doing, but when they want to compare classes, they must arrange their statistics in other ways. One way is to find out how many students in each class received each grade; another is to compare the *range* of grades from high to low and calculate the average grade in each class.

Frequency Distributions

When statistics are arranged according to the number of times (the frequency) with which each item occurs, the arrangement is called a *frequency distribution.*

Suppose you made a survey of the earnings during a certain week of the 35 students of Central High School who have jobs, and collected the following *data* ("data" means *facts*):

Name	*Earnings*	*Name*	*Earnings*
Audrey Barber	$2.00	Norman Kruse	$2.50
Louis Bower	2.75	Henry Lee	2.75
Albert Brown	2.50	Edward Martin	3.25
Robert Burger	3.50	James McDonald	3.75
James Caldwell	4.00	Ellen Merick	2.25
Dorothy Coleman	3.00	Louis Meyer	3.50
Allen Davis	3.75	Frank Morris	2.75
Henry Douglas	1.50	Otto Nelson	3.00
Ann Frost	1.75	Harold Otis	3.50
Carol Fuller	2.25	David Owens	3.25
Betty Gilmore	2.00	Virgil Peters	2.25
Arthur Green	4.25	Edna Porter	3.00
Harry Griffin	4.00	Edward Pope	2.75
Fred Hall	2.50	Bill Smith	2.50
Lois Henderson	2.75	Carol Starkey	1.75
Robert Hill	3.25	Mary Stone	3.25
Rita Johnson	2.50	William Taylor	3.00
Bernice Kelch	2.75		

This listing is useful to someone who wants to know how much a certain student earned in one particular week, but it is not very useful to someone who wants a general understanding of the earnings of Central High students. Therefore you would make a frequency distribution. Proceed in this way:

(1) List the amounts earned *in order of size* in a vertical column. (See column 1 in Table 27, page 510.)

(2) Look at each item of data in turn, and place a tally after the corresponding number in your column of amounts earned. (See column 2 in Table 27.)

(3) Count the number of tallies after each amount, and write that number. (See column 3 in Table 27.)

Table 27. EARNINGS OF 35 STUDENTS OF CENTRAL HIGH SCHOOL DURING WEEK OF APRIL 12, 19—: FREQUENCY DISTRIBUTION

Earnings	*Tallies*	*Number*
$4.25	/	1
4.00	//	2
3.75	//	2
3.50	///	3
3.25	////	4
3.00	////	4
2.75	~~////~~ /	6
2.50	~~////~~	5
2.25	///	3
2.00	//	2
1.75	//	2
1.50	/	1

A graph of a frequency distribution is called a *histogram.* A histogram looks like a bar graph without spaces between the bars. The frequencies are always indicated on the vertical reference line. Figure 14–12 is a histogram of the frequency distribution in Table 27.

PROBLEMS

1. Study the frequency distribution and the histogram showing the earnings of the Central High School students, then answer the questions that follow.

a. How many students earned $1.50 during the week of April 12? How is this fact shown in the histogram?

b. How many students earned $1.75 during the week?

c. How many students earned less than $2.50 during the week?

d. How many students earned $3.00 or more during the week?

2. The numbers of hours worked one week by 30 employees of the East Side Laundry were as follows:

44	40	43	46	41
43	46	47	48	47
46	42	44	49	50
47	44	42	43	50
45	48	47	46	45
45	47	42	44	41

a. What was the greatest number of hours worked by an employee?

b. What was the smallest number of hours worked?

c. Make a frequency distribution showing the number of hours worked by these employees.

d. Draw a **histogram** from your frequency table.

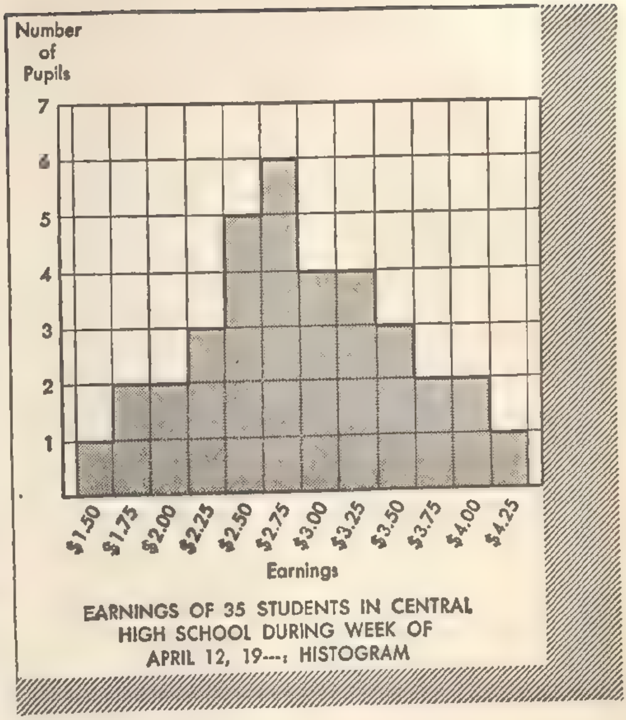


Figure 14–12

3. One week the men on a job worked these hours:

40	41	45	37	43	44	36	43	44	39
38	39	41	42	37	46	33	34	42	38
35	43	36	30	45					

a. What was the greatest number of hours worked by a man on this job?

b. What was the smallest number of hours worked?

c. Make a frequency distribution of these data.

d. Make a histogram of these data.

4. The students in the first-period mathematics class took a computation test consisting of 20 problems. The number of problems each student worked correctly is reported here:

18	20	17	15	19	17	19	20	15	7	18	17
13	19	20	20	18	19	19	17	20	19		

Make a histogram showing these scores.

5. The table which follows shows the tax charged on a gallon of gasoline by the various states in a recent year. The Federal tax on gasoline is not included.

STATE GASOLINE TAXES, BY STATES: 19—

State	*Tax*	*State*	*Tax*	*State*	*Tax*
Alabama	$.06	Maine	$.04	Ohio	$.04
Arizona	.05	Maryland	.04	Oklahoma	.075
Arkansas	.065	Massachusetts	.03	Oregon	.05
California	.03	Michigan	.03	Pennsylvania	.04
Colorado	.04	Minnesota	.04	Rhode Island	.03
Connecticut	.03	Mississippi	.06	South Carolina	.06
Delaware	.04	Missouri	.02	South Dakota	.04
Florida	.07	Montana	.05	Tennessee	.07
Georgia	.06	Nebraska	.05	Texas	.04
Idaho	.06	Nevada	.04	Utah	.04
Illinois	.03	New Hampshire	.04	Vermont	.04
Indiana	.04	New Jersey	.03	Virginia	.06
Iowa	.04	New Mexico	.05	Washington	.05
Kansas	.04	New York	.04	West Virginia	.05
Kentucky	.05	North Carolina	.06	Wisconsin	.04
Louisiana	.07	North Dakota	.04	Wyoming	.04

a. What was the highest state tax per gallon of gasoline in this particular year?

b. What was the lowest tax?

c. Make a frequency table showing the number of states which charged a tax of 2 cents per gallon, 3 cents per gallon, and so on.

d. Draw a histogram from your frequency table.

Averages

"The average age of the people at the party was 16." What kind of party does that statement suggest to you? Actually, it doesn't tell very much about the party. You don't know whether it was large or small — there might have been 6 people there, or 60. It doesn't tell whether the people present were all about 16 years old, or whether they ranged in age from babies to parents. Whenever you report an average, remember to tell also the *number* of cases from which the average was found and the *range* of values. A good description of the party would have been this: "The nineteen people

BLACK STAR

When facts have been collected from large numbers of people, as in the United States Census, machines are used to sort and classify the data. The counts appear on the machine indicators, and are tabulated by an operator.

at the party ranged in age from 12 to 20; the average age was 16."

The word *average* in this description refers to the *mean;* that is, to the kind of average found by adding the separate ages and dividing the sum by the number of people present.

Although the description gives the number, range, and mean, it still leaves a lot to the imagination. Maybe several of those present were 16; maybe none of them was. Maybe there was only one twelve-year-old; maybe there were several children aged 12. As a matter of fact, the distribution of the ages was as follows:

12	//
13	///
14	////
15	/
18	~~////~~
20	////

Notice that as many of those present were under 15 as were over 15; that is, 15 is the middle number in the series. The middle number in a series is called the *median.* A median is another kind of average.

Still another kind of average is the *mode* The mode is the number that appears most frequently in a list of numbers. The mode of the ages of the people at the party was 18. There were more people 18 years old than people of any other age.

A complete statistical description of the people present at the party would be this: "The 19 people at the party ranged in age from 12 to 20. The mean of their ages was 16; the median was 15; and the mode was 18."

It is not likely that you will want to describe many parties in this way. But it is likely that you will want to describe other situations in statistical terms.

Example

The members of the International Club of East High School pledged themselves to make weekly contributions to a foreign relief fund. The confidential pledges were as follows:

$.15	$.05	$.10	$.25	$.05	$.05	$.10
.05	.25	.20	.05	.05	.20	.35
.10	.25	.15	.50	.10	.25	.50
.05	.05	.05	.20			

In reporting to the Club, the treasurer told the range, median, mean, and mode of the amounts. Calculate these statistics.

What to Do	How to Do It
(1) Make a frequency distribution of the data. From the frequency distribution, find the number of cases, the range of values, the median, and the mode.	.50 // 2 .35 / 1 .25 //// 4 .20 /// 3 .15 /// 3 .10 //// 4 .05 ~~////~~ /// 8 Number: 25 Range: $.05–$.50 Median: $.15 Mode: $.05
(2) To find the mean, add the individual values, and divide the sum by the number of cases.	2 × .50 = $1.00 1 × .35 = .35 4 × .25 = 1.00 3 × .20 = .60 3 × .15 = .45 4 × .10 = .40 8 × .05 = .40 25)$4.20($.17 Mean

PROBLEMS

1. The members of the senior class of Memorial High School sell soft drinks at home basketball games in order to raise

money for the annual senior trip. The student in charge of the project consulted the records left by the last graduating class. He found that the number of bottles sold per game had been as follows:

240	252	300	324	324	348	300	324	264
324	348	348	252	360	372	324	252	228
204	360	360	360	348	300	288	372	

He reported the range, mean, median, and mode of these figures. What did he report?

2. The weekly earnings of the employees in the cod-liver oil department of the Professional Pharmaceutical Manufacturing Company were as follows:

$35.00	$42.50	$40.00	$35.00	$70.00	$50.00
$35.00	$37.50	$35.00	$62.50	$50.00	$50.00
$37.50	$40.00	$27.50	$47.50	$42.50	$35.00
$30.00					

Find the range, median, mean, and mode of these wages.

3. Find the range, median, mean, and mode of the weekly salaries received by the workers in one department of the Municipal Gas Works. The individual salaries are as follows:

Worker	*Salary*	*Worker*	*Salary*	*Worker*	*Salary*
G. Anders	$50	J. Hannon	$40	G. Olson	$35
J. Berkowitz	45	O. Hussey	65	G. Pickard	62
E. Cannon	60	C. Jeffrey	40	F. Powers	50
N. Deane	37	L. Kearney	40	B. Rae	60
E. Emery	55	R. Larson	37	V. Strong	35
P. Foss	60	B. McGee	35	J. Triggs	40
R. Glazer	40	W. Newell	55	E. Weeks	55

4. Mr. Washburn had the tank of his car filled each time he bought gasoline. He recorded the number of gallons put in. His record for three months follows:

7.5	7.5	8.0	6.0	13.5	8.0
11.0	12.5	8.0	8.0	11.0	12.0
13.0	11.0	7.5	8.0	9.6	9.0
13.0	8.0	12.0	9.0	12.5	13.5
12.0	13.0	10.2			

Give the range and three kinds of averages of these data.

5. Mr. Richards gave the same mathematics test of 20 problems to the students in two of his classes. The scores were as follows:

Sixth Period Class			*Seventh Period Class*		
19	13	14	17	19	17
20	16	18	16	17	16
12	19	15	14	15	17
18	15	17	13	14	15
15	16	13	15	13	14
16	18	16	17	17	16
14	15	16	20	18	19
13	17	12	15	12	11
14	14	15	18	20	18
16	15	17	16	14	15
14			16	17	12

To compare the classes, Mr. Richards made a table showing the highest and lowest scores in each class, the range, the arithmetic mean, the mode, and the median.

a. Prepare such a table.

b. Which class do you think did better on the test? Explain your answer.

How You Can Use Statistics

There are many occasions on which people find an ability to use statistics valuable. Here are three examples:

1. The Student Council of a certain school was dissatisfied with the way in which school activities were supported. Since talking about the situation did not improve it, a committee collected the facts about attendance at games, track meets, plays, and parties, and about participation in clubs, student government meetings, and field trips. When the facts were presented in such a way as to show what a small per cent of the student body accepted responsibility for school activities, many more people began to participate, and school spirit improved remarkably.

2. Poison ivy was a real problem to certain students. They asked these and similar questions of everyone in the junior and senior high schools: Do you get poison ivy when exposed to it? If you do, how many times did you have poison ivy this year? How severe was your worst case? What does poison ivy cost you in money spent for ointments, injections, and doctor's fees? What does it cost you in time lost from school or vacation activities? While collecting and organizing such facts, they wrote to the State College of Agriculture for information on methods of eradicating the weed and the cost of eradication. When they presented their facts to the town officials, town funds were spent on eradicating poison ivy from that community, and today it is practically impossible to find any poison ivy there.

3. A group of students wanted to start a teen-age center in their village. They realized that in order to obtain sponsors, they would have to show that such a center would fill a real need and would be at least partly self-supporting. So they surveyed the teen-age population of the village to find out how many young people wanted and would use such a center; how often each person would expect to visit it; how much money each person ordinarily spent on refreshments, juke boxes, and the like; and how many people would contribute time to tending the refreshment bar and doing other chores around the place. They made charts setting forth their data in interesting ways, and obtained permission to present their findings to a meeting of the high school parents association. As a result, a group of business men in the village became sponsors of a teen-age club room.

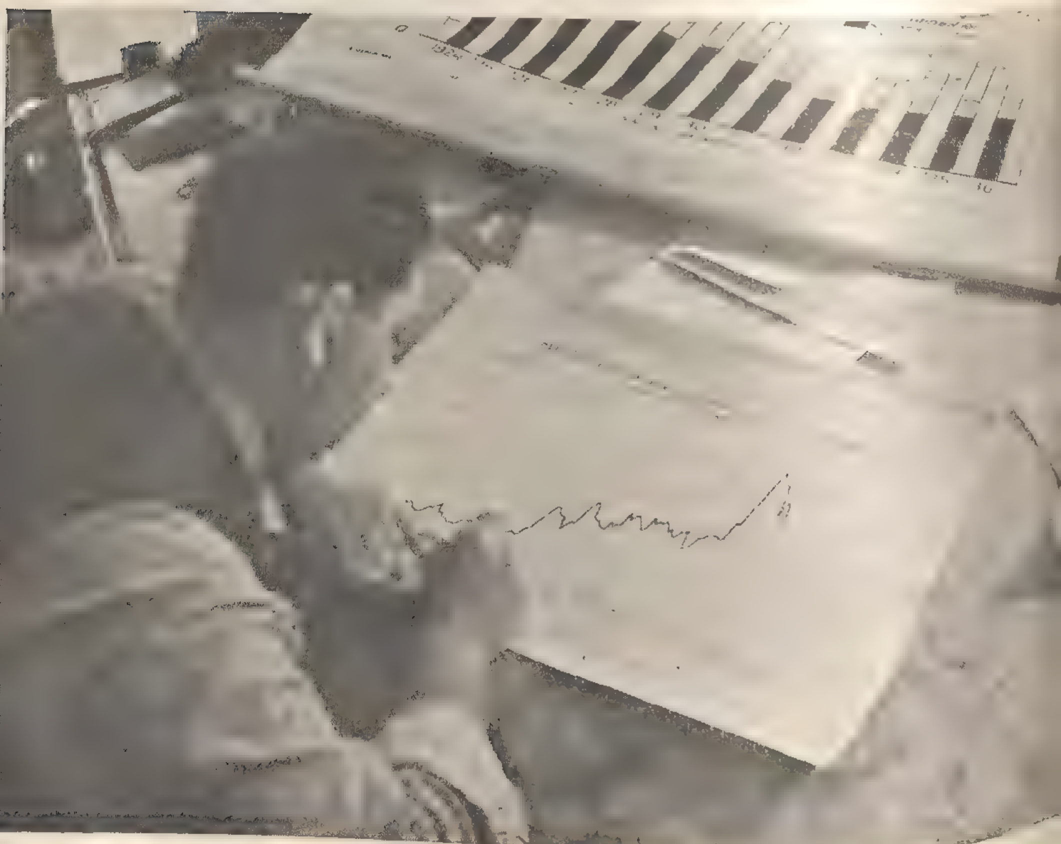
Can you think of problems in your own school or community? Real problems are everywhere, and many of them can be attacked by interested persons and groups. If you were to put into action what you have learned in this chapter, you might be doing something really worth while.

What You Have Learned in This Chapter

1. To read statistical tables for general information and for particular facts and relationships
2. To present facts in the form of tables, supplying complete titles and appropriate headings for columns
3. To read bar graphs, line graphs, and graphs showing fractions or per cents
4. To present facts in the form of graphs
5. To make frequency distributions and histograms
6. To describe data by telling the number of cases, the range of the values, and three kinds of averages
7. To use the following terms correctly: *reference lines, data, histogram, range, mean, median, mode*

This employee of the United States Department of Agriculture is preparing graphs showing changes in agricultural production from year to year.

GALLOW



Review Test on Statistics

For this test you should have a ruler and, preferably, squared paper.

1. The various continents are listed below, and next to each is shown the number of barrels of crude petroleum produced in 1940.

Africa	6,532,000
Asia	183,142,000
Australia and New Zealand	3,000
Europe	279,416,000
North America	1,428,246,000
South America	246,537,000

a. Present this information in the form of a statistical table, supplying a title and headings for each of the columns.

b. According to your table, which of the following statements do you know to be correct?

(1) The United States produced more crude petroleum in 1940 than any other country.
(2) The crude petroleum produced in Australia and New Zealand is of a very poor quality.
(3) North America produced more crude petroleum in 1940 than all the rest of the world combined.
(4) North America produced the best grade of crude petroleum in 1940.
(5) There is more oil in the ground in South America than there is in Africa.

2. The scores made by May Anderson on her monthly mathematics tests were as follows:

October	12
November	13
December	16
January	15
February	16
March	18
April	20
May	20

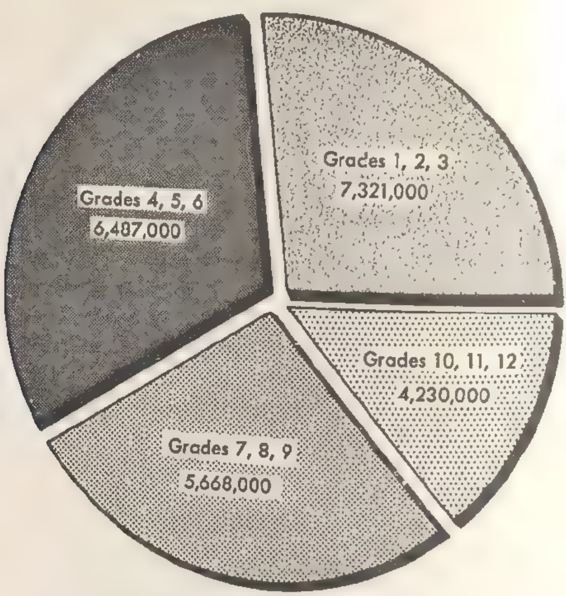
Use this information to make a bar graph.

3. Make a line graph showing the average weight of fifteen-year-old American girls of various heights. Use the data in the following table:

AVERAGE WEIGHT OF FIFTEEN-YEAR-OLD AMERICAN GIRLS 60 TO 72 INCHES TALL

Height (*inches*)	*Weight* (*pounds*)
60	107
62	113
64	119
66	127
68	135
70	143
72	151

4. Answer questions *a* to *f* by referring to the circle graph that follows:



ENROLLMENT IN GRADES 1 TO 12 OF THE PUBLIC SCHOOLS OF THE UNITED STATES: 19..

a. What was the total enrollment in grades 1 to 12 in the year for which the graph was drawn?

b. What was the size of the enrollment in grades 7, 8, and 9?

c. What per cent of the total enrollment was the enrollment in grades 7, 8, and 9?

d. What was the size of the enrollment in grades 10, 11, and 12?

e. What per cent of the total enrollment was the enrollment in grades 10, 11, and 12?

f. Calculate the size of the angle that forms the part of the circle that indicates the enrollment in grades 10, 11, and 12.

5. The employees of the Olsen Manufacturing Company made the following contributions to the Community Chest Fund:

\$1	\$5	\$5	\$8	\$10	\$2	\$3	\$6	\$5	\$5
\$10	\$3	\$4	\$5	\$5	\$1	\$2	\$2	\$8	\$5
\$3	\$3	\$5	\$7	\$3	\$5	\$5	\$15	\$1	\$2
\$4	\$1	\$1	\$2	\$2					

a. Make a frequency distribution of the data.

b. From the frequency distribution, tell the number and range of the contributions, the median contribution, and the mode.

c. Calculate the mean contribution.

d. Make a histogram of the data.

How do you rate?	Excellent	Good	Fair	Poor
	5	4	3	2 or less

CHAPTER 15

FREDERIC LEWIS

But what is it that
each observer has
the RIGHT to do?
Obviously ONLY to do his BEST . . .
To measure as accurately as
possible . . .
to think straight
(as judged by the best standards of
modern mathematicians and logicians),
and NOT MERELY TO HECKLE!

H. G. and L. R. Lieber, *The Education of T. C. Mits*, W. W. Norton, 1944

GEOMETRY

PRACTICAL MEASUREMENT AND DESIGN

WHETHER OR NOT you realize it, you use geometry constantly. Are you interested in photography? Whenever you take a picture, you apply principles of geometry. Are you a gardener? When you plan your garden, you use geometry. Do you like to make patchwork quilts, afghans, or rugs? Are you the "handyman around the house" who lays linoleum, builds cupboards, and paints walls? Do you play baseball or billiards, golf or croquet? All these activities and many more require you to know something of geometry.

Measuring Lines

An important part of geometry is measuring. In fact, the word *geometry* originally meant "land measurement." Of course, you have made many measurements. The accuracy with which you made them varied: sometimes a rough estimate was enough for your purpose; sometimes you measured as precisely as you could.

The *units* in which you expressed your measurements varied, too. When you "clocked" the distance from one town to the next, you reported the result in miles and tenths of a mile. When you measured your little brother's height, you told him how tall he was in feet and inches. When you marked off lines for lettering a poster, you probably made your

measurements in quarter-inches. When you measured the diameter of a bolt in machine shop, you noted the result in thirty-seconds or sixty-fourths of an inch. All these units are units of length.

Units of Length

As you know, units such as inches, feet, and yards are related to each other. They make up the system of measures which is in everyday use in English-speaking countries; that is, the United States system (or the English system). The facts about these units of length are summarized in Table 28.

Table 28. UNITED STATES UNITS OF LENGTH AND THEIR EQUIVALENTS

Inches *in.*	*Feet* *ft.*	*Yards* *yd.*	*Rods* *rd.*	*Miles* *mi.*
12	1			
	3	1		
	$16\frac{1}{2}$	$5\frac{1}{2}$	1	
	5280	1760	320	1

In other countries, the *metric system* of measures is used. The units in this system are related to each other decimally; therefore it is easy to compute with them. Metric units are being used more and more in this country. Study Table 29 to learn the names and abbreviations of the metric units of length and how each unit is related to the others.

Table 29. METRIC UNITS OF LENGTH AND THEIR EQUIVALENTS

Millimeters *mm*	*Centimeters* *cm*	*Meters* *m*	*Kilometers* *km*
10	1		
1000	100	1	
		1000	1

Probably you are already familiar with the unit called the *meter,* for you have heard of the 100-meter dash and other track and swimming events. One meter is a little longer than a yard. If you were to visit the continent of Europe, you would find distances from place to place expressed in kilometers; one kilometer is a little more than half a mile. If a French "pen pal" should tell you his height, he would express it in centimeters; a centimeter is a little less than half an inch. More exact equivalents are given in Tables 30 and 31.

Table 30. UNITED STATES EQUIVALENTS OF METRIC UNITS OF LENGTH

Metric Unit	*U. S. Unit*
1 cm	.39 in.
1 m	39.37 in.
1 km	.6 mi.

Table 31. METRIC EQUIVALENTS OF UNITED STATES UNITS OF LENGTH

U. S. Unit	*Metric Unit*
1 in.	2.54 cm
1 ft.	.3 m
1 yd.	.9 m
1 rd.	5.0 m
1 mi.	1.6 km

PROBLEMS

Refer to the tables on pages 524 and 525 as you solve these problems.

1. A field is 40 rods long and 20 rods wide. Give the dimensions of the field:

a. in feet. **b.** in yards.

2. A farm is 140 rods wide and 200 rods long. Express the length and width of the farm:

a. in feet. **b.** in yards.

3. When driving along a parkway, you see a sign reading, "Toll House 1000 ft. Ahead." What is the distance from the sign to the toll house in miles (to the nearest tenth of a mile)?

4. Suppose you are walking along a road and come to a sign reading, "500 yards to gas station." Express your distance from the gas station in miles (to the tenth of a mile).

5. In the winter Olympic Games there is an 18-kilometer ski race. Express the length of the course in miles.

6. Jim and Bill were touring Europe on bicycles. One day they decided to ride to a town 32 kilometers away from their last stop. How long a trip was this in miles?

7. A candid camera uses 35-millimeter film. How wide is the film in inches (to the nearest tenth inch)?

8. Classroom motion picture projectors usually use 16-

GALLOWAY

Careful and accurate measurement is a necessary part of many jobs in industry. This workman is making a wood pattern for a machine.

millimeter film. How wide is the film in inches (to the nearest tenth of an inch)?

9. A standard course for swimming races is 400 meters. Express this distance:

a. in feet.
b. in yards.

10. A certain short-wave radio station broadcasts on a wave length of 35 meters. What is this wave length:

a. in feet.
b. in yards.

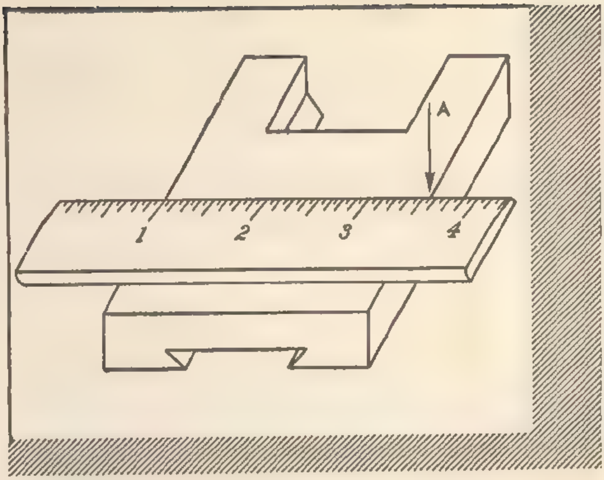


Figure 15–1

The Right Way to Measure Lengths

When you measure a length with a ruler, meter stick, or tape there are certain precautions that you should take to insure accuracy. Three of these are shown in Figure 15–1.

(1) Begin your measurement at some other point than the end of the ruler. The end of a ruler is the first part to become worn, and it may be inaccurate.

(2) Bring the marks of the ruler as close as possible to the object you are measuring.

(3) Observe the mark on the ruler from directly above. Arrow A shows the direction in which to look.

Another wise precaution is to make a second measurement, starting at a different point on the ruler. For the second reading, the ruler in Figure 15–1 might be placed so that the $\frac{1}{2}$-inch mark is at the left edge of the object.

A good way to record your measurements is like this:

Object: Pattern Block	*Right-hand end*		*Left-hand end*		*Difference (Length)*
First Reading:	$3\frac{9}{16}$	−	1	=	$2\frac{9}{16}$ in.
Second Reading:	$3\frac{1}{16}$	−	$\frac{1}{2}$	=	$2\frac{9}{16}$ in.

PROBLEMS

In doing these problems, use a ruler marked in sixteenths of an inch. Report your measurements as shown on page 527.

1. Measure each of the following lines:

a.

b.

c.

d.

e.

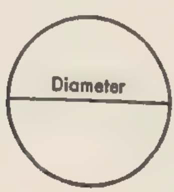
2. Draw lines of the lengths given below. Use a metric scale to measure each line you draw to the nearest millimeter.

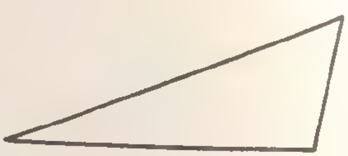
a. 3 in. **b.** $2\frac{3}{4}$ in. **c.** $3\frac{15}{16}$ in. **d.** $1\frac{1}{2}$ in. **e.** 1 in.

3. Measure the diameter of the circle below. Using $\pi = \frac{22}{7}$, calculate its circumference. (The circumference of a circle is π times the diameter).

4. Measure each of the sides of the triangle below. Compute its perimeter (distance around the figure).

5. Close this book and measure its length, width, and thickness. Report your measurements to the nearest eighth inch.





Reading Scale Drawings

The ability to measure lines accurately is useful when reading scale drawings. Figure 15–2, page 529, is a scale drawing of a garage. The scale as given on the drawing is 1 in. = 10 ft. This scale means that 1 inch on the plan represents an actual length of 10 feet.

You can find the dimensions of tne garage, its door, and its windows by measuring the lengths of the lines in the drawing, and multiplying.

Example Find the inside width of the garage drawn to scale in Figure 15–2.

What to Do	How to Do It
(1) Find the number of inches in the line that represents the distance you want to know.	By measurement, line = $1\frac{7}{8}$ in.
(2) Multiply the number of inches in the line by the length each inch represents.	1 in. = 10 ft. $1\frac{7}{8}$ in. = $1\frac{7}{8} \times 10$ ft. $\frac{15}{8} \times 10 = \frac{75}{4} = 18\frac{3}{4}$ ft.
(3) Express the result in feet and inches.	$18\frac{3}{4}$ ft. = 18 ft. 9 in. Answer

PROBLEMS

All these problems are based on the first-floor plan of a house with attached garage, shown on page 530. Make your measurements to sixteenths of an inch.

1. Find the total length of the house, from the outside of the chimney to the outside wall of the garage.

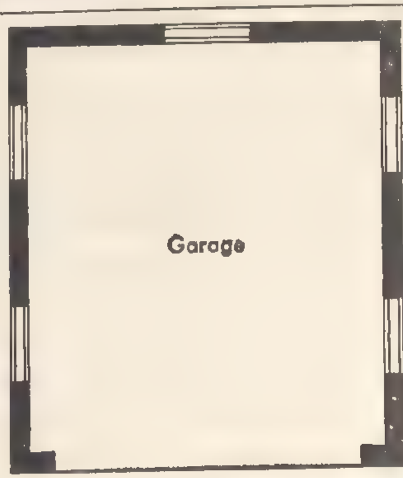
2. Find the total width of the house, from the bay windows to the outer porch wall.

3. Find the length and width of the porch.

4. Find these dimensions of the hall:

a. Its length, from the front door to the entrance to the porch

Figure 15–2



Scale 1 In. =10 Ft.

b. Its width at the widest portion

c. Its width at the narrowest portion

5. Find the width of each window in the living room.

Scale: 1 In. = 20 Ft.

Measurement in Drawing to Scale

The ability to make accurate measurements is at least as important in making scale drawings as it is in reading them. You will make scale drawings on many occasions. You may draw plans to follow in building things — bookcases, perhaps, or toys. You may lay out a vegetable garden, or plan the planting and walks for the grounds around your house. You may design the stage setting for the school play or party decorations to make the school gymnasium look like a roof garden or the deck of an ocean liner. You may decide to rearrange the furniture in a room or to plan the house you hope to live in some day.

To make a scale drawing, you should, of course, know the dimensions of the actual object you are representing. Then select a scale to use, such as 1 in. = 1 ft. or $\frac{1}{2}$ in. = 3 ft. The scale should be such that the drawing will fit on the paper you plan to use. Next calculate how long a line to use for each dimension, and make your drawing so that it is the same shape as the object you are representing.

To calculate the length of a line on the drawing, divide the actual length by the length represented by 1 inch. For

example, if you are using a scale of 1 in. = 2 ft., and you must represent 12 feet, you should draw a line 6 inches long:

$$12 \div 2 = 6$$

PROBLEMS

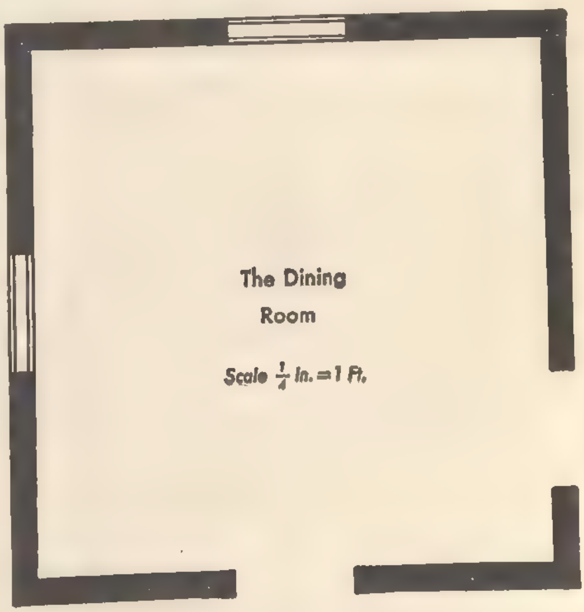
In making the scale drawings required in the problems that follow, use a ruler marked in sixteenths of an inch. Make as accurate measurements as you can. Use a sharp pencil so that the lines will be clean-cut, and a protractor to get your angles accurate.

1. A rectangular garden plot is 12 feet long and 5 feet wide. Make a scale drawing that could be used in planning the arrangement of the vegetables to be grown.

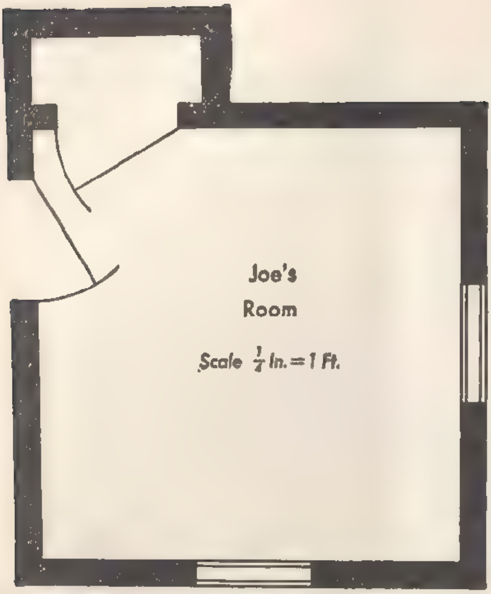
2. Tom is planning to build a doll bed for his little sister's birthday present. He thinks the frame should be 28 inches wide and 52 inches long. Make a scale drawing of the frame.

3. A gas range is 36 inches long and 22 inches wide. It is placed against a wall, and 6 inches of floor space are left on each of the other three sides. Make a scale drawing showing these facts.

4. A dining room is 12 feet square. The windows and doors are as shown in the drawing. The dining room table is 2 feet 6 inches wide and 6 feet long. There are eight dining room chairs, each 18 inches square. The only other piece of dining room furniture is a buffet 2 feet wide and 5 feet long. Make a scale drawing of the dining room and its furniture, showing how you would place each piece.



5. The Jacksons are about to move into a new house. Joe is to



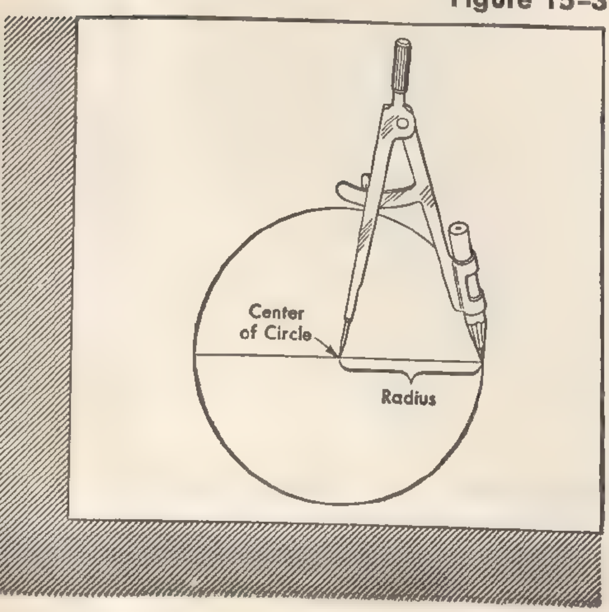
have a room 10 feet square, with windows, door, and closet as shown in the drawing. Joe's furniture consists of a bed 42 inches by 82 inches; a chest of drawers 18 inches by 34 inches; a desk 22 inches by 42 inches; two chairs, each 16 inches by 19 inches; and a bookcase 12 inches by 36 inches. Make a scale drawing of Joe's room, showing how he might place his furniture.

Making Geometric Constructions

There are many times when it is convenient to know how to lay out geometric figures accurately. You can probably name instances from your own experience, such as making picture frames, cutting patches for a quilt, and building models of ships or airplanes.

The tools you need are a ruler (or any straight-edge) and a compass (see Figure 15–3).

Figure 15–3



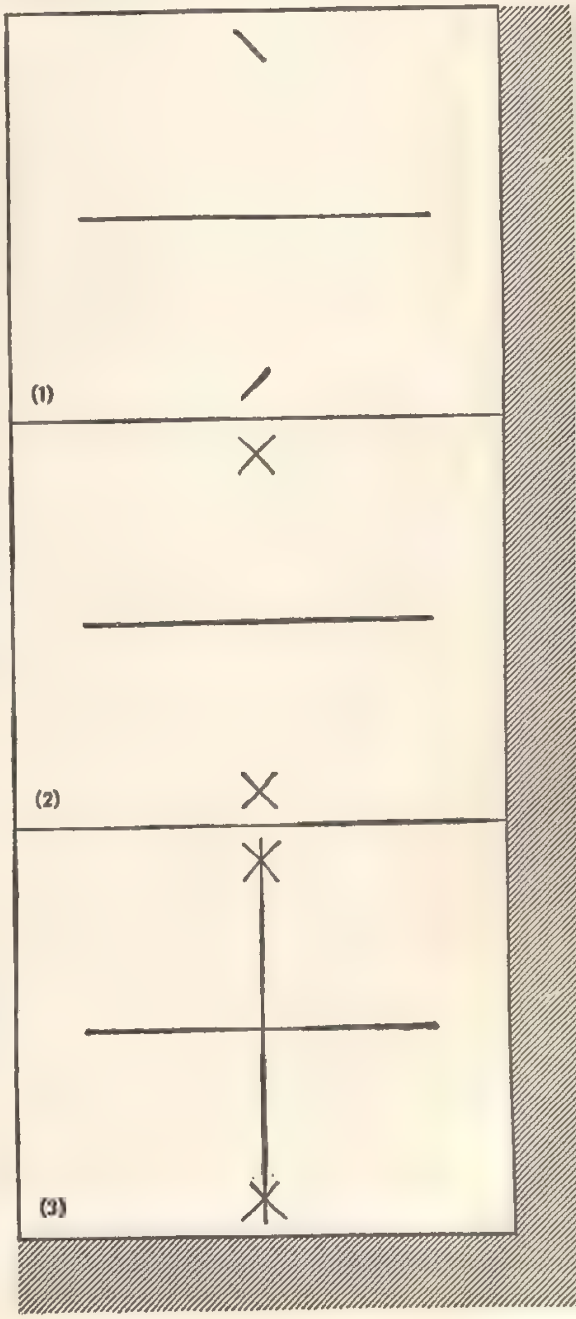
Perpendicular Lines

There are many situations in which you may have to construct *perpendicular lines* (lines at right angles to each other), but only three *kinds* of situations. The steps you must take in each case are given on pages 533–535, and are illustrated in the figures next to the directions.

The first kind of situation occurs when you want to divide a line in half (that is, *bisect* it) by means of a perpendicular.

EXAMPLE A. *Draw a perpendicular that bisects a line.*

Figure 15–4



(1) Open your compass so that its radius is more than half as long as the line. You need not measure the radius. Put the metal point of the compass at one end of the line. Draw an arc (part of the circumference of a circle) above the line and another below it.

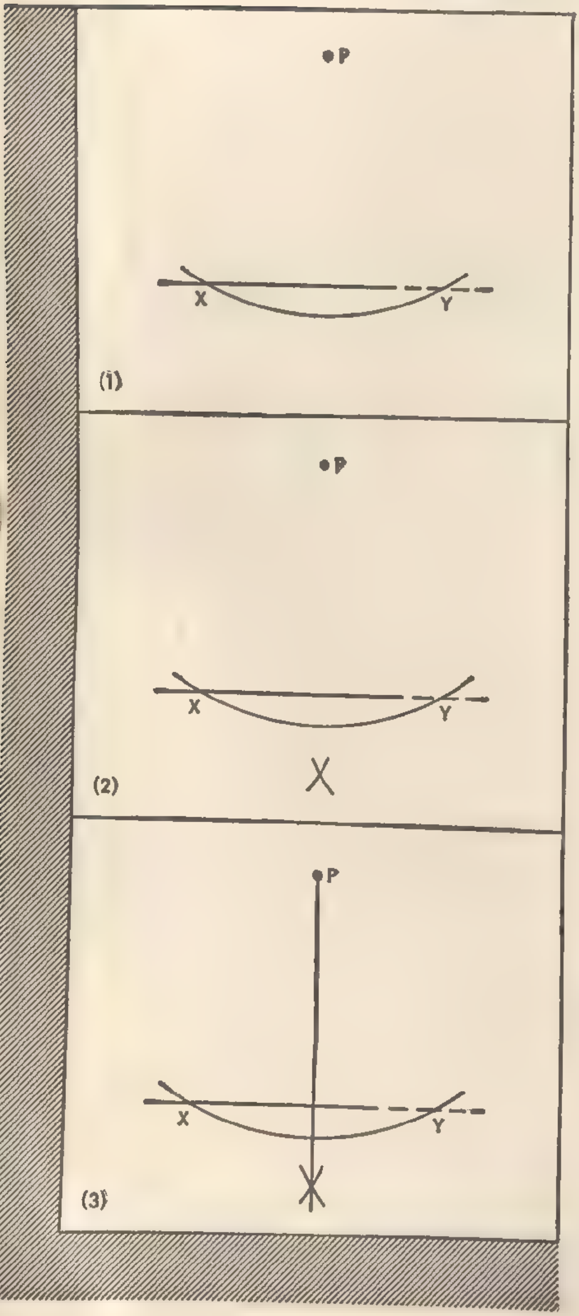
(2) Without changing the radius, move the metal point of the compass to the other end of the line. Draw arcs above and below the line as before. These arcs should cross the ones already drawn.

(3) Draw a straight line connecting the points where the arcs cross. The line you draw is the *perpendicular bisector* of the other line.

The second kind of situation occurs when you must draw a perpendicular to a line from some outside point.

EXAMPLE B. *Draw a perpendicular from a point to a line.*

Figure 15-5



(1) Open your compass so that its radius is longer than the shortest distance from the point to the line. Place the metal point of the compass on the given point (P). Draw an arc that crosses the line at two places (X and Y). If necessary, draw dashes to make the line longer.

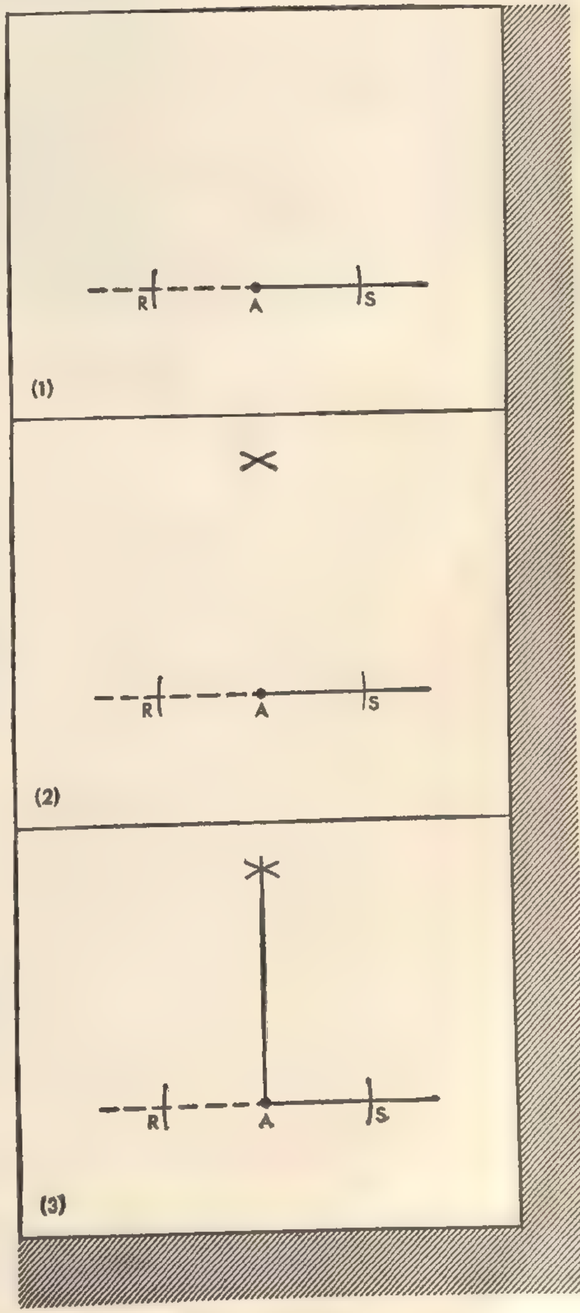
(2) Move the metal compass point to point X. Using any radius greater than half the distance from X to Y, draw an arc on the other side of the line from P. Without changing the radius, move the compass point to Y and repeat. The two arcs should cross.

(3) Draw a straight line connecting P with the point where the two arcs cross. The line you draw is perpendicular to the other line.

The third kind of situation occurs when you must draw a perpendicular to a line at some point on that line.

EXAMPLE C. *Construct a perpendicular at a point on a line.*

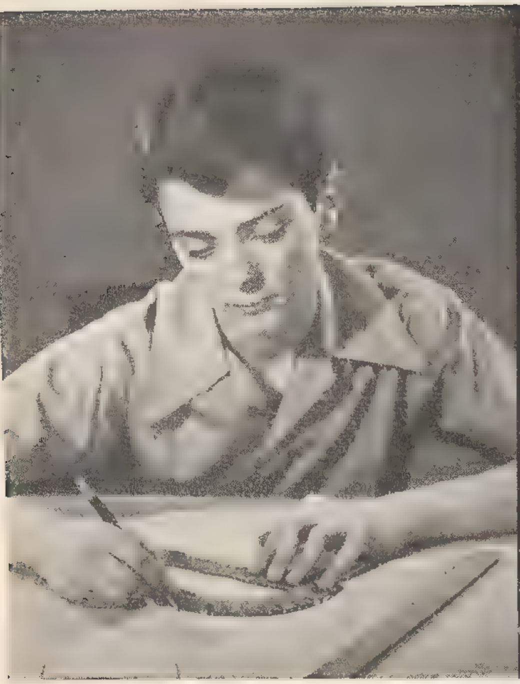
Figure 15-6



(1) Using any radius, place the metal point of the compass on the given point (A). Draw arcs crossing the line on both sides of A (at R and S). Extend the line if necessary.

(2) Increase the radius of the compass and place the metal point on R. Draw an arc above point A. Without changing the radius, move the compass point to S and repeat. The two arcs should cross.

(3) Draw a straight line connecting A with the point where the two arcs cross.



GALLOWAY

BLACK ST

Studying angles in school is one of the early steps toward understanding how bridges and other structures are designed and built.

PROBLEMS

Make these constructions using only a ruler and a compass. Then measure the angles with a protractor.

1. Draw a horizontal line 4 inches long. Call the line AB. Place a mark on it 1 inch from the left end at point C. Place a dot about 2 inches above the line. Call the dot point D.

a. Construct a perpendicular line that will divide AB into two equal parts.

b. At point C, construct a line perpendicular to AB.

c. Construct a perpendicular line from point D to line AB.

d. Construct a line perpendicular to AB at A.

2. Construct a triangle that contains a right angle.

3. Draw a triangle whose angles are all less than right angles. Construct the line representing the triangle's height.

4. Draw a triangle that contains an angle greater than a right angle. Construct the line that represents the height of this triangle.

5. Draw a rectangle. Divide it into four equal rectangles.

Angles of Various Sizes

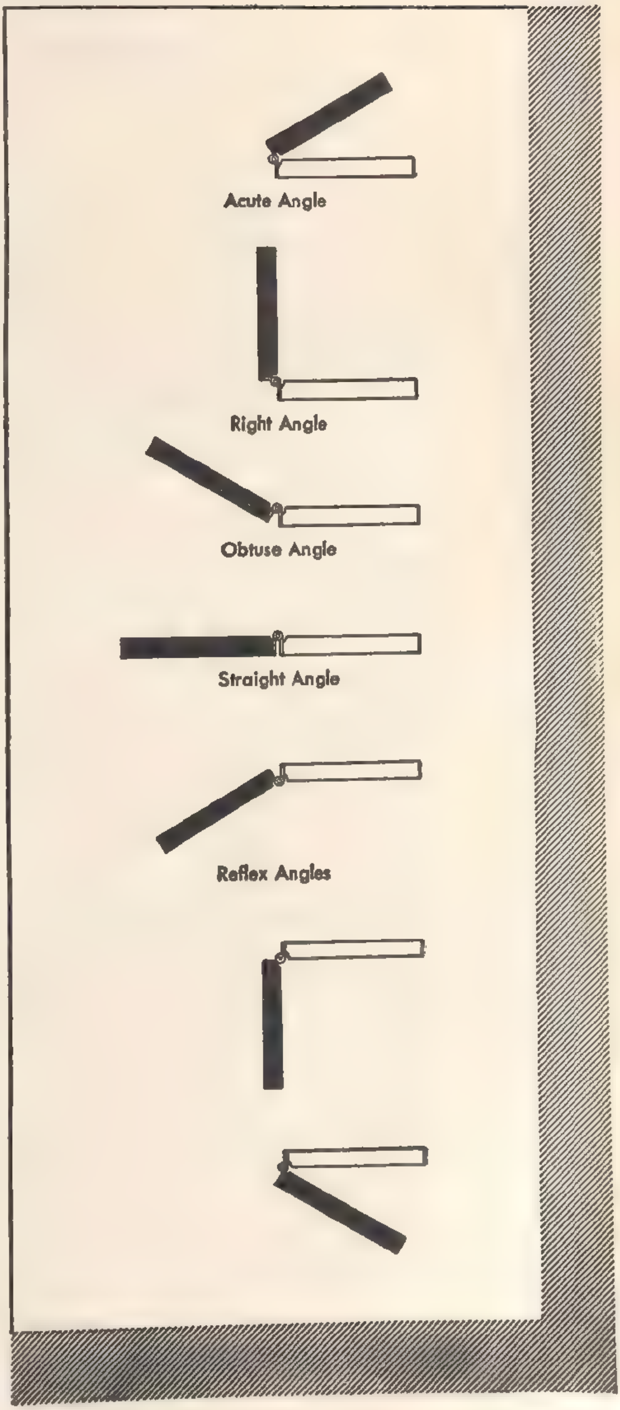
You can construct right angles by constructing perpendicular lines. But suppose you were making a working drawing of a room plan that included bay windows. You would have to construct angles other than 90-degree ones. Of course, you could use a protractor, but to do so seldom gives as accurate results as does the use of ruler and compass.

You know that 90-degree angles are called right angles. Angles containing between 90 degrees and 180 degrees are called *obtuse angles*. Angles containing fewer than 90 degrees are called *acute angles*.

Figure 15–7 shows two pieces of wood, hinged together. As the black piece is moved to different positions, the space between the pieces represents different kinds of angles.

The examples on pages 538 and 539 show you how to proceed to construct acute and obtuse angles. Draw any angle, and use it in following the directions given.

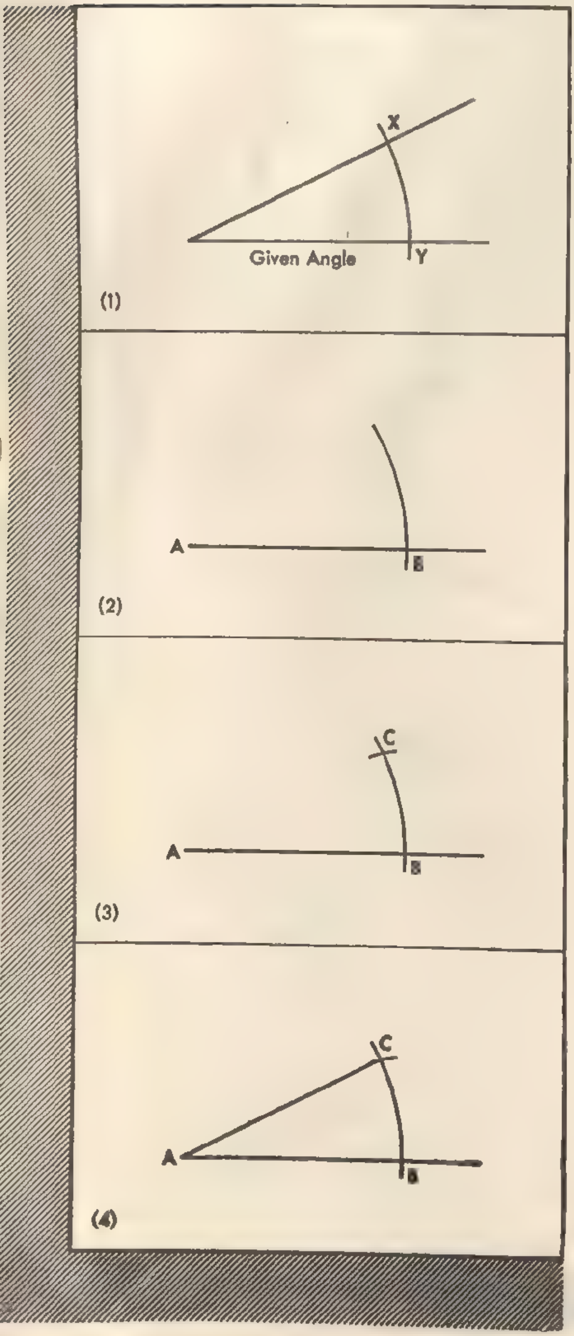
Figure 15–7



One kind of situation in which you may want to construct an angle occurs when you must copy an angle exactly.

EXAMPLE A. *Construct an angle equal to a given angle.*

Figure 15-8



(1) Place the metal point of your compass on the vertex (point) of the given angle, and draw an arc crossing both its sides. Call the points where the arc crosses points X and Y.

(2) Draw a line to serve as one side of the angle you are constructing. Place the compass point at one end of this line (at point A). Without changing the radius, draw an arc about as long as the first arc. Call the point where the arc crosses the line point B.

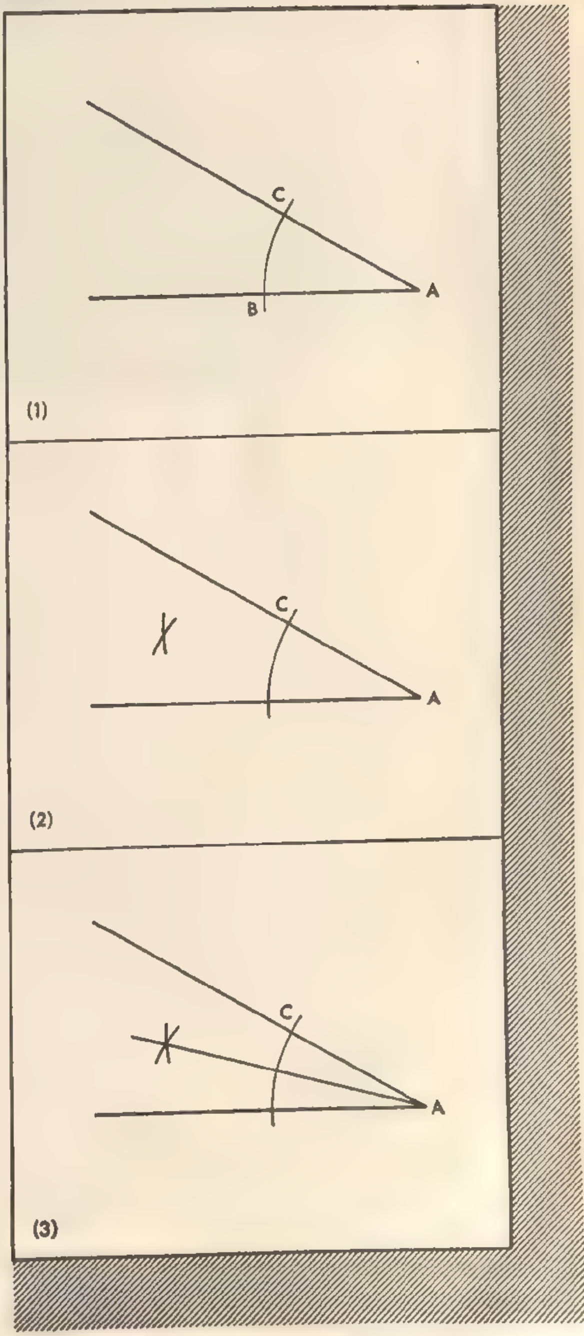
(3) Change the radius of the compass, making it equal the distance XY. Put the metal point on B and draw an arc crossing the arc that goes through B. Call the point where the two arcs cross point C.

(4) Draw a straight line connecting points A and C. The resulting angle is equal to the original angle.

The other kind of situation occurs when you want to divide an angle into two equal parts (to *bisect* an angle).

EXAMPLE B. *Draw any angle and bisect it.*

Figure 15–9



(1) Place the metal point of the compass on the vertex of the angle to be bisected (on point A). Draw an arc crossing both sides of the angle. Call the points where it crosses points B and C.

(2) Place the compass point on B and draw an arc opposite A. Without changing the radius, move the compass point to C and repeat. The two arcs should cross.

(3) Draw a straight line connecting A with the point where the two arcs cross.

FREDERIC LEWIS

The horizontal surfaces of these steps are parallel to each other, and so are the vertical surfaces. Several kinds of angles may be found in the picture.

PROBLEMS

Use only ruler and compass to make these constructions.

1. Draw any acute angle and bisect it. Draw a triangle in which one angle is equal to the acute angle you started with and one angle is equal to half that acute angle.

2. Draw any obtuse angle and bisect it. Draw a four-sided figure in which one angle is equal to the obtuse angle and another is equal to half that angle.

3. Draw any triangle. Bisect each of its angles. If your work is accurate, the bisectors will meet at a single point.

4. Construct a triangle with angles equal to 90 degrees, 45 degrees, and 45 degrees.

5. Draw any triangle. Construct another triangle larger than the first, in which each angle is equal to an angle in the original triangle.

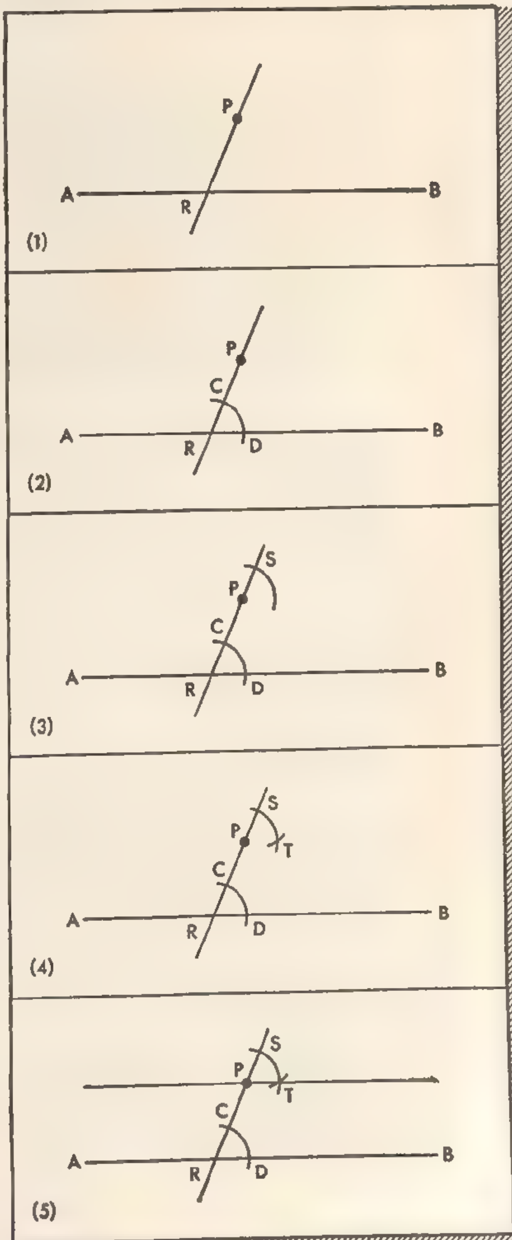
Parallel Lines

Parallel lines are lines that never meet, no matter how far they are extended. If you have ever tried to rule parallel lines on a sheet of paper you know that some lines are likely

to slant a little. But you can draw lines that are actually parallel by using a straightedge and compass.

EXAMPLE. *P is a point above line AB. Draw a line through P parallel to AB.*

Figure 15–10



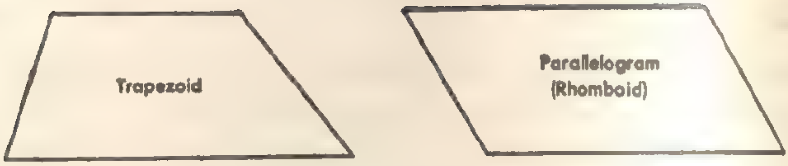
(1) Draw a line through P crossing AB. Call the point where it crosses point R.

(2) Place the metal compass point on R. Using any radius, draw an arc crossing both lines. Call the points where it crosses C and D.

(3) Without changing the radius, move the compass point to P. Draw an arc about as long as the first arc. Call the point where it crosses PR point S.

(4) Move the compass point to C. Adjust the radius so that it equals the distance CD. Then put the compass point at S and draw an arc. It should cross the arc that goes through S. Call the point where it crosses point T.

(5) Draw a straight line through P and T.



PROBLEMS

Make the constructions called for with ruler and compass.

1. Draw a horizontal line MN with a point B below it. Construct a line through B parallel to MN.

2. Draw a vertical line 3 inches long with a point 2 inches to the right of it. Construct a parallel line through the point.

3. Construct a four-sided figure having two and only two sides parallel (a trapezoid).

4. Construct a four-sided figure that does not contain a right angle but does have two pairs of parallel sides (a *rhomboid*, or a parallelogram that is not a rectangle).

5. Construct a six-pointed star (*Hint:* You will need to draw three pairs of parallel lines.)

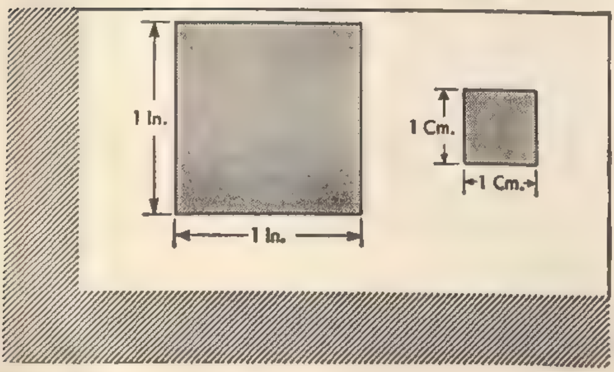
Finding Areas from Measurements of Length

The ability to make geometric constructions is often useful in finding areas. In general, finding areas involves computing with measurements of length. Whenever you calculate an area, you multiply the number of units of length in one dimension by the number of units of length in another dimension. The result is a number of units of area.

Units of Area

The larger drawing in Figure 15–11 is a square with sides each 1 inch in length; that is, it is 1 square inch. The square inch is a unit of area. So is the square foot, which is a square with each side 1 foot in length. The facts about the units of area in the United States system are summed up in Table 32. Remember that each unit of area represents a square.

Figure 15–11



Of course, there are units of area in the metric system, too; and these also are squares. The smaller square in Figure 15–11 is a square centimeter. You will probably have much less occasion to use metric units of area than to use metric units of length.

Table 32. UNITED STATES UNITS OF AREA AND THEIR EQUIVALENTS

Square Inches sq. in.	*Square Feet sq. ft.*	*Square Yards sq. yd.*	*Square Rods sq. rd.*	*Acres A*	*Square Miles sq. mi.*
144	1				
	9	1			
	$272\frac{1}{4}$	$30\frac{1}{4}$	1		
			160	1	
				640	1

PROBLEMS

Refer to Table 32 for the facts you need to solve these problems.

1. How many square inches are in 1 square yard?

2. Express 1 square mile in terms of:

a. square rods b. square yards

3. Express 1 acre in terms of:

a. square yards b. square feet

4. The city of Grand Rapids, Michigan, has an area of 23 square miles. How many acres does it cover?

5. The Black Mountain game refuge in Arkansas contains 19,074 acres. What is its area in square miles?

Rectangular Areas

A rectangle is a figure with four sides and four right angles. A square is a rectangle with four equal sides. In Figure 15–12, page 545, a rectangle with a base (length) of 8 inches and a height (width) of 3 inches is drawn to scale. Each small square represents 1 square inch. There are three

rows of 8 squares each, or 24 squares in all. The area of this rectangle is 24 square inches. The square in Figure 15–12 has a side of 5 inches, drawn to scale. The square is divided into square inches. There are 5 rows of 5 small squares each. The area of this rectangle is 25 square inches.

The area of a rectangle equals the number of units in the base multiplied by the number of units in the height.

Area of a rectangle	=	number of units in base	×	number of units in height		
A	=	b	×	h		
Area of "1," Fig. 15–12	=	5	×	5	=	25 sq. in.
Area of "2," Fig. 15–12	=	8	×	3	=	24 sq. in.

PROBLEMS

Be sure to tell in what units each area is expressed. Refer to Table 32 if necessary.

1. Find how many square inches of copper are needed to cover the bottom of a box 8 inches wide and 20 inches long.

2. A garden plot is 80 feet wide and 125 feet long. How many square feet does it contain?

3. A rectangular field is 80 yards by 160 yards. How many square rods does it contain?

4. Mr. Stone has a rectangular field of corn and wishes to calculate the number of acres in it. The field is 495 feet wide and 1485 feet long. How many acres does it contain?

5. Mr. Canton, a contractor, estimated the cost of building a cement floor at $.32 per square foot. Find the cost of building a floor 28 feet wide and 42 feet long.

6. In planting a field 60 rods by 120 rods, Mr. Burke estimates that he will use 3 bushels of seed per acre. How many bushels of seed does he need?

7. Mr. Brobeck harvested 1800 bushels of oats from a field 80 rods square (that is, 80 rods by 80 rods). How many

bushels per acre did he harvest?

8. The specifications for building a factory state that the window space must be 15 per cent of the floor space. How many square feet of window space is needed for a room 30 feet by 45 feet?

9. In buying paint for his house, Mr. Williams estimated that one gallon of paint was needed for each 100 square feet of surface.

a. How many gallons must he buy to cover four surfaces each 18 feet by 24 feet?

b. What is the cost if the paint costs $4.59 per gallon?

10. Mr. Baker wishes to buy fertilizer for a field 30 rods wide and 80 rods long. He estimates that he needs 500 pounds per acre.

a. How many pounds of fertilizer does he need?

b. What is the cost of the fertilizer at $7.50 per ton (1 ton = 2000 pounds)

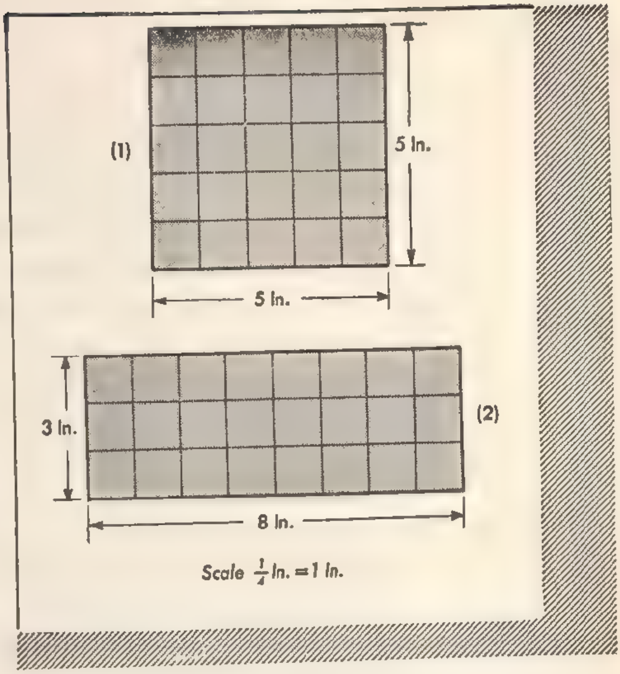


Figure 15–12

Triangular Areas

When you draw the diagonal of a rectangle, you divide the rectangle into two triangles. The square in Figure 15–13 is divided

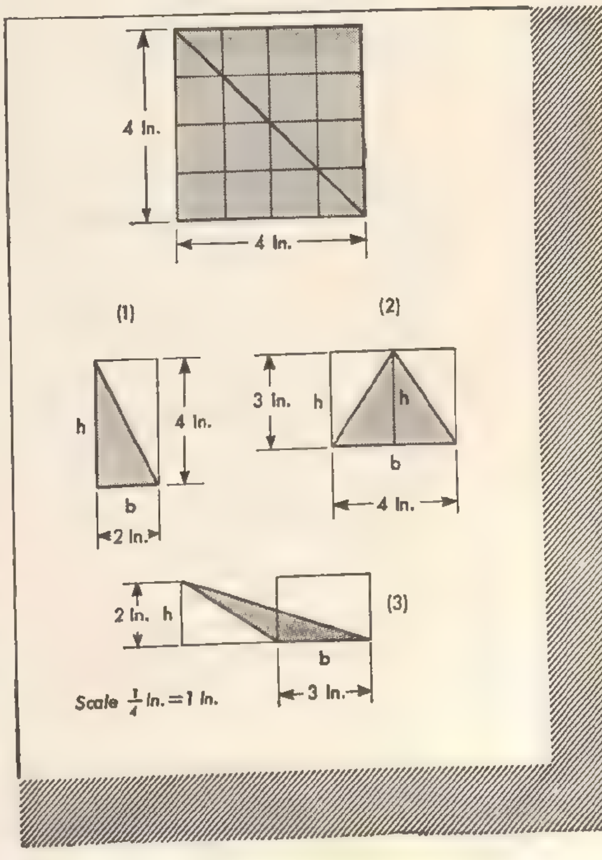


Figure 15–13

by a diagonal into two triangles. As you can see, the area of one triangle is equal to the area of the other; the area of each triangle is just half the area of the square.

By similar tests you can discover that any triangle has an area just half the area of a rectangle with the same base and height. (See the other sketches in Figure 15-13.) The height (sometimes called the *altitude*) of a triangle is the perpendicular distance from one of the points (called the *vertex*) to the base or an extension of the base.

The area of any triangle is equal to half the product of the number of units in the base and the number of units in the height.

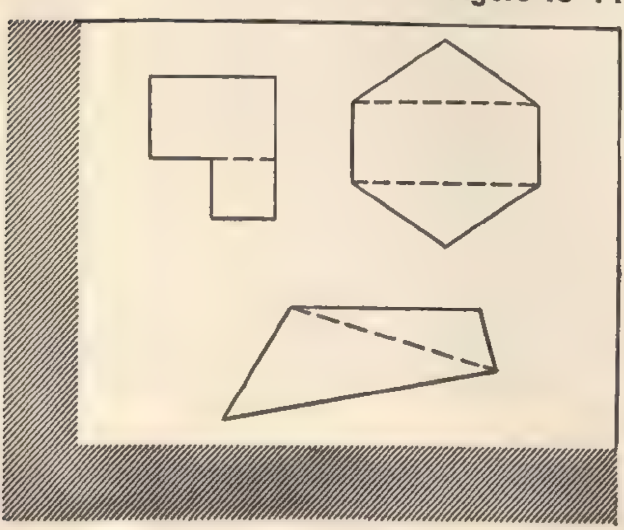
Area of a triangle	=	$\frac{1}{2}\times$	number of units in base	$\times$	number of units in height		
A	=	$\frac{1}{2}\times$	b	$\times$	h		
Area of "1," Fig. 15–13	=	$\frac{1}{2}\times$	2	$\times$	4	=	4 sq. in.
Area of "2," Fig. 15–13	=	$\frac{1}{2}\times$	4	$\times$	3	=	6 sq. in.
Area of "3," Fig. 15–13	=	$\frac{1}{2}\times$	3	$\times$	2	=	3 sq. in.

PROBLEMS

Make a sketch to help you solve each of these problems.

1. How many square inches are there in a triangular pennant whose height is 14 inches and whose base is 10 inches?

Figure 15–14



2. A railroad cut off one corner of a farm. The piece of land cut off formed a triangle with a height of 40 rods and a base of 54 rods. How many square rods were cut off the farm?

3. Four triangular pieces of canvas were used to make a tent. The base of each piece was 4 feet in length;

the height was 5 feet 6 inches. How many square feet were in the tent?

4. Bill Campbell wishes to cut a triangular piece of tin from a rectangular sheet 12 inches by 18 inches. The altitude of the triangle is 10 inches and the base is 16 inches.

a. How many square inches of tin will there be in the triangular piece?

b. How many square inches of tin will be left?

5. A rectangular farm is 100 rods by 60 rods. A ditch cuts off one corner in such a way that a triangle is formed with a base of 45 rods and a height of 30 rods.

a. How many acres are there in the triangular portion?

b. How many acres are there in the rest of the farm?

Other Areas Bounded by Straight Lines

By using what you know about the area of a rectangle and the area of a triangle, and what you know about geometric construction, you can find the area of any figure bounded by straight lines. All you have to do is to draw lines dividing a figure into rectangles and triangles, find the areas of the separate pieces, and add them together. Figure 15–14, page 546, suggests how to proceed.

When you treat a parallelogram in this way, you get two equal triangles, as shown in Figure 15–15. Both triangles have the same height, since the opposite sides of a parallelogram are parallel and parallel lines are the same distance apart at every point. The area in Figure 15–15 may be found as follows:

$$\begin{aligned} A &= \tfrac{1}{2} \times b \times h \\ \text{Area of "1"} &= \tfrac{1}{2} \times 8 \times 4 = 16 \text{ sq. in.} \\ \text{Area of "2"} &= \tfrac{1}{2} \times 8 \times 4 = \underline{16 \text{ sq. in.}} \\ \text{Area of parallelogram} &= 32 \text{ sq. in.} \end{aligned}$$

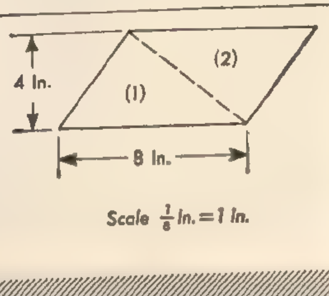


Figure 15–15

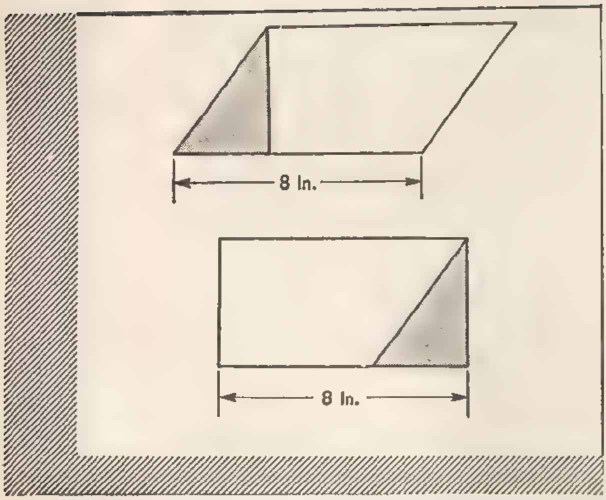


Figure 15-16

The area of this parallelogram is the same as the area of a rectangle with a base of 8 inches and a height of 4 inches. Figure 15-16 shows why. The rectangle is constructed of the same pieces as the parallelogram above it.

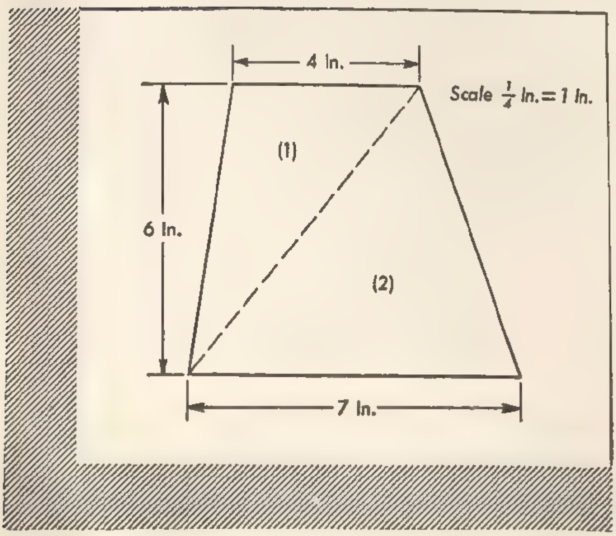
Of course, a rectangle is a parallelogram—both pairs of opposite sides are parallel. It is a special kind of parallelogram in that it contains four right angles.

$$\text{Area of a parallelogram} = \begin{array}{c}\text{number of units}\\ \text{in base}\end{array} \times \begin{array}{c}\text{number of units}\\ \text{in height}\end{array}$$

$$A = b \times h$$

Figure 15-17 shows a trapezoid divided into triangles. A trapezoid is a four-sided figure that has one pair of parallel sides. Because one pair of sides is parallel, the height of the two triangles is the same. But the bases of the triangles are of different lengths; so each triangle has a different area.

$$\begin{aligned} A &= \tfrac{1}{2} \times b \times h \\ \text{Area of "1"} &= \tfrac{1}{2} \times 4 \times 6 = 12 \text{ sq. in.} \\ \text{Area of "2"} &= \tfrac{1}{2} \times 7 \times 6 = \underline{21 \text{ sq. in.}} \\ \text{Area of trapezoid} &\qquad\qquad\quad = 33 \text{ sq. in.} \end{aligned}$$



The area of this trapezoid is the same as the area of a triangle with a base of 11 inches and a height of 6 inches.

$$A = \tfrac{1}{2} \times 11 \times 6 = 33 \text{ sq. in.}$$

Figure 15-17

You will see why if you study Figure 15–18. The large triangle is constructed of the same pieces as the trapezoid. The bases of the large triangle contains the same number of unit as both the bases of the trapezoid. Its height is the same as the height of the trapezoid. So you can find the area of a trapezoid by multiplying half the sum of the units in the bases by the number of units in the height.

$$\text{Area of a trapezoid} = \tfrac{1}{2} \times \begin{array}{c}\text{sum of units}\\ \text{in bases}\end{array} \times \begin{array}{c}\text{number of units}\\ \text{in height}\end{array}$$

$$A = \tfrac{1}{2} \times (b_1 + b_2) \times h$$

When you find the area of a trapezoid directly, always add the units in the bases *first.*

PROBLEMS

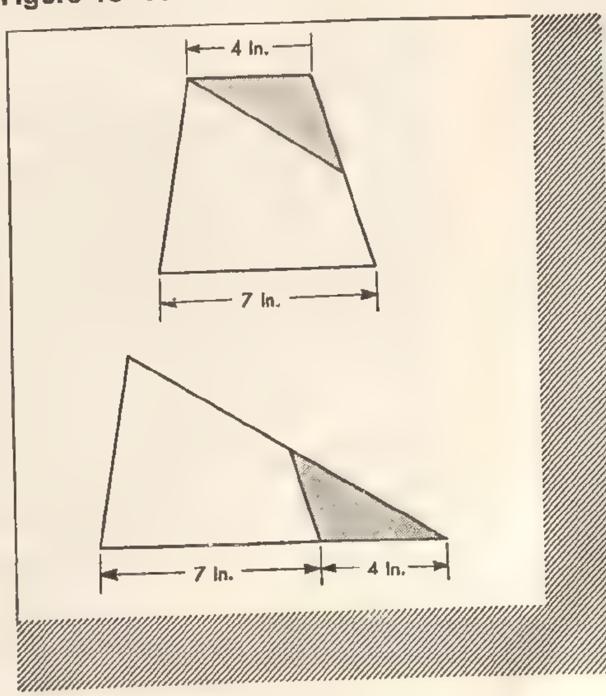
Make a scale drawing for each of these problems. Use a protractor if you wish, as well as ruler and compass.

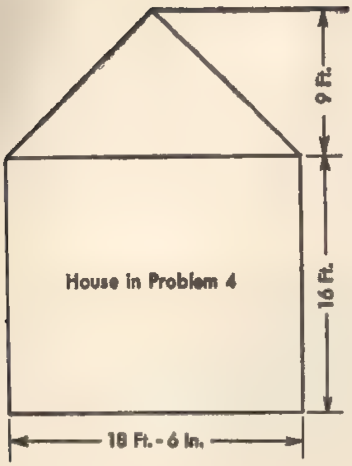
1. Some of the windows in the Reynolds' house have right-angled panes. The sides of the panes are of equal length, each 10 inches. What is the area of one of the panes?

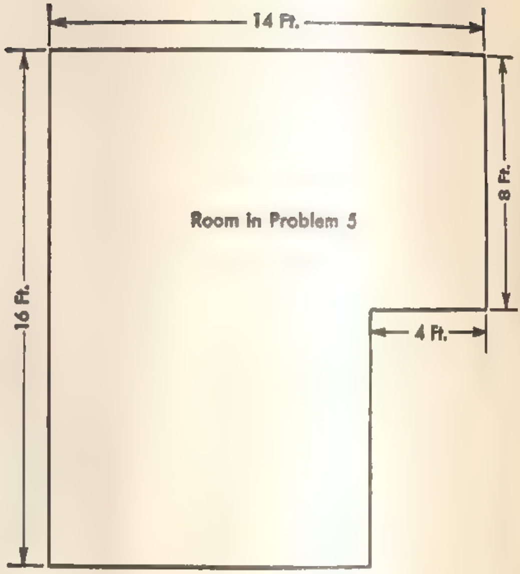
2. Sally is cutting patches to use in making a quilt. Certain patches are to be in the shape of a parallelogram, with sides 4 inches long and 3 inches apart. What is the area of each of these patches?

3. A shed with a sloping roof is 9 feet 6 inches high in front and 8 feet high in back. The shed is 20 feet long. What is the area of the side of the shed? (Note that the side has the shape of a trapezoid.)

Figure 15–18







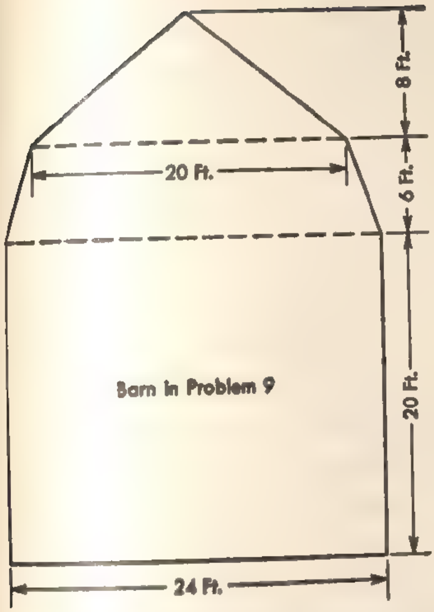
4. Find the area of the end of the house shown above.

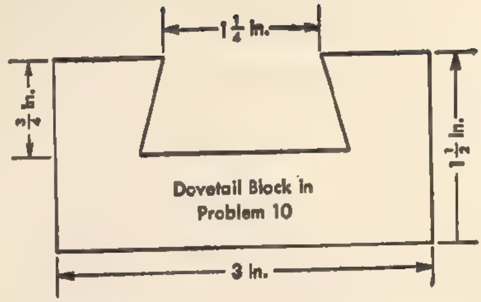
5. Mr. Roberts wishes to cover a floor with linoleum. The floor has the dimensions shown in the drawing at the top of the page. How much will the linoleum cost at $2.10 per square yard?

6. A roof has the shape of a trapezoid whose parallel edges are 28 feet and 38 feet long. The distance between them is 16 feet. How many bundles of shingles must be purchased to shingle one side of this roof, if 3 bundles will cover 100 square feet?

7. The sides of a metal waste basket are made of sheets of sheet metal in the shape of trapezoids whose slanting sides are equal in length (as in the sketch at the right). The parallel sides of each trapezoid are 10 inches and 12 inches long, and the distance between them is 15 inches. How many square inches of metal are required for the four sides of the waste basket?

8. Find the number of square inches of material in a lamp shade made of six pieces, each having the shape of a trapezoid. The parallel sides of each piece are 10 and 14 inches long,





and the distance between them is 7 inches. The non-parallel sides are equal in length.

9. Find the area of the end of the barn shown above.

10. Find the area of the dovetail block sketched above. The cut is a trapezoid whose non-parallel sides are equal, and whose bases are $1\frac{1}{4}$ and $1\frac{3}{4}$ inches in length.

Circular Areas

To find the area of a circle, you must work with the number called *pi* (written π). Have you ever wondered about that number? Where does it come from? Why is its value $3\frac{1}{7}$?

Thousands of years ago, people noticed that whenever they measured both the circumference and the diameter of a circle, they found the circumference to be $3\frac{1}{7}$ times the diameter. The number $3\frac{1}{7}$ kept appearing so often that finally someone began using a letter — a Greek letter, π — in referring to it.

The circumference of a circle is always $3\frac{1}{7}$ times the diameter of the circle. You can check this statement by drawing circles and measuring their circumferences and diameters. For example, using a radius of $3\frac{1}{2}$ inches (a diameter of 7

inches), draw a circle on cardboard, then cut it out and wrap a tape measure around the circumference. You will find the circumference to be 22 inches.

Circumference $= \pi \times$ diameter

$C = \pi \times d$

$C = \pi \times 2 \times r$ or $C = 2\pi r$

(multiplication signs understood)

$C = 3\frac{1}{7} \times 2 \times 3\frac{1}{2} = 22$ in.

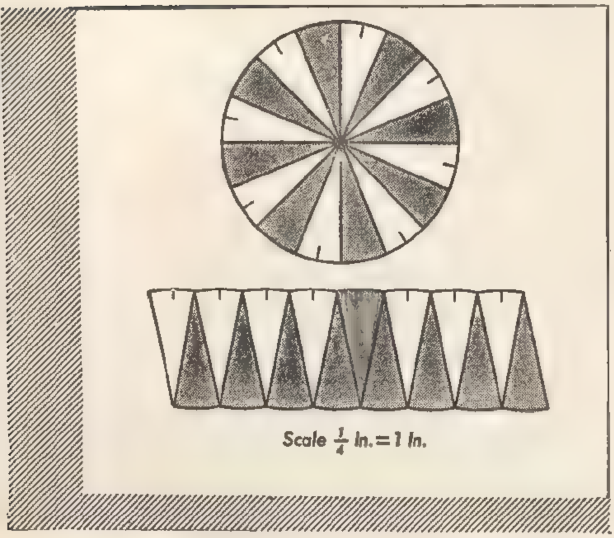


Figure 15–19

A circle with radius of $3\frac{1}{2}$ inches is drawn to scale in Figure 15–19. It has been divided into 16 equal parts. When the parts are rearranged, a figure much like a parallelogram results. The base of the parallelogram is made up of the edges of the gray parts of the circle; in other words, the base is just half as long as the circumference of the circle. The height of the parallelogram is the same length as the radius of the circle.

The area of a parallelogram is equal to the product of the base and the height	$A = b \times h$
The base of this parallelogram is half the circumference of the circle	$A = \frac{1}{2}C \times h$
In any circle, $C = 2\pi \times r$; so $\frac{1}{2}C = \pi \times r$ . .	$A = \pi \times r \times h$
The height of this parallelogram is equal to the radius of the circle; therefore	$A = \pi \times r \times r$

From the fact that $A = \pi \times r \times r$, you can find the area of the circle, for you know its radius. Of course, the area of the circle is the same as the area of the parallelogram, for the two figures are made of the same pieces.

To find the area of the circle in Figure 15–19:

$A = \pi \times r \times r$

$A = 3\frac{1}{7} \times 3\frac{1}{2} \times 3\frac{1}{2}$

$A = \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} = \frac{77}{2}$

$A = 38\frac{1}{2}$ sq. in.

To find the area of the parallelogram in Figure 15–19:

$A = b \times h$

$A = 11 \times 3\frac{1}{2}$

$A = 11 \times \frac{7}{2} = \frac{77}{2}$

$A = 38\frac{1}{2}$ sq. in.

The area of any circle is equal to the product of π and the radius multiplied by itself. To show that a quantity is multiplied by itself, it is customary to write a small 2 next to it and slightly above it.

Area of a circle $= \pi \times$ radius multiplied by itself

$A = \pi \times r^2$ or $A = \pi r^2$

(multiplication signs understood)

PROBLEMS

Make drawings to help in solving these problems.

1. Mr. Atkinson made a circular flower bed 14 feet in diameter on a part of his front lawn.

a. How many square feet of lawn did he destroy?

b. He planted bulbs 8 inches apart around the border of the flower bed. How many bulbs did he plant? (*Hint:* To answer the question, first find the circumference of the plot.)

2. Mrs. Taber has a round mirror 22 inches in diameter.

a. What is the circumference of the mirror?

b. She wishes to have the mirror resilvered. What will the job cost at $1.25 per square foot?

3. Mr. Burt cut a circle with a circumference of $31\frac{1}{2}$ inches from a piece of tin 12 inches square.

a. Find the diameter to the nearest quarter inch.

b. What was the area of the circle?

c. How many square inches of tin were left over?

4. A circular grass plot in Memorial Park has a diameter of 32 feet. Recently the plot was resodded and a gravel walk 3 feet wide constructed around it.

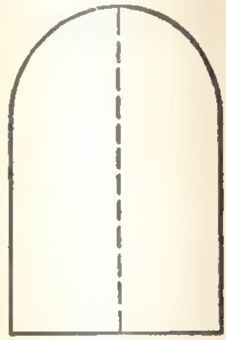
a. How many square feet of sod were required?

b. What is the total area of the grass plot and walk?

c. What is the area of the gravel walk?

d. What is the length of the outer edge of the walk?

5. The archway sketched at the right is 4 feet 6 inches wide. At its highest portion, it is 6 feet 9 inches high. What is its area? (*Hint:* The opening consists of a square with a half circle added to it.)



Scale $\frac{1}{4}$ in. = 1 ft

Volumes and Surfaces of Solids

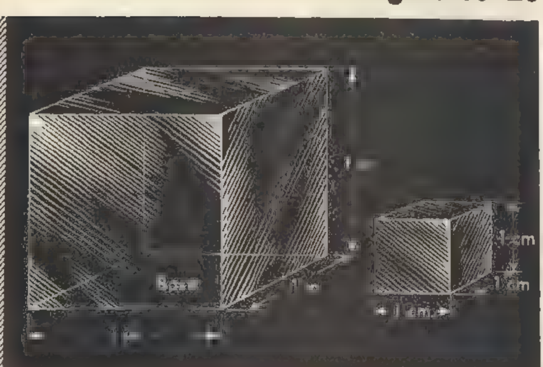
A solid figure is one that has three dimensions: length, width, and thickness. A three-dimensional object is called a solid even if it is hollow; for example, an empty box is a solid. (In mathematics, solid is not the opposite of liquid.)

Units of Volume and Capacity

In Figure 15–20 a cube with sides each 1 inch in length is represented; that is, the figure represents 1 cubic inch. The cubic inch is a unit of volume. So is the cubic foot, which is a cube with a base of 1 square foot and a height of 1 foot. The cubic yard is also a unit of volume. The relationships among these units are given in Table 33, page 555.

The metric system includes such units of volume as the cubic centimeter, also pictured in Figure 15–20, and the cubic meter. One cubic centimeter is about $\frac{6}{100}$ of a cubic inch; and 1 cubic meter is slightly larger than a cubic yard.

Figure 15–20



Volume, as measured by cubic inches, cubic centi-

Table 33. UNITED STATES UNITS OF VOLUME AND THEIR EQUIVALENTS

Cubic Inches *cu. in.*	*Cubic Feet* *cu. ft.*	*Cubic Yards* *cu. yd.*
1,728	1	.037
46,656	27	1

meters, and the like, refers to the space a solid occupies. It should not be used to mean the amount that can be put into a hollow solid, such as a tin can. The amount that can be put into a container is called its *capacity*.

Units of capacity are pints, pecks, and the like. In the United States there are two systems of units of capacity, one for "dry" commodities and one for liquids. (You studied these systems in Chapter 5, pages 187–188.) The units of capacity used in the metric system are shown in Table 34. You will probably hear these units mentioned, and you may have some occasion to use them yourself, so you should know that a *liter* (lee′ter) is approximately equal to a quart.

Table 34. METRIC UNITS OF CAPACITY AND THEIR EQUIVALENTS

Milliliters *ml*	*Liters* *l*	*Kiloliters* *kl*
1000	1	
	1000	1

Of course, there is a relation between units of capacity and units of volume. For example, a gallon of liquid occupies 231 cubic inches of space. The number of cubic inches occupied by a few units of capacity is given in Table 35. If you should need to do so, you could calculate the number of cubic inches occupied by other units of capacity from that information.

Table 35. NUMBER OF CUBIC INCHES OF SPACE OCCUPIED BY VARIOUS UNITS OF CAPACITY

Unit of Capacity	*Number of Cubic Inches*
1 liquid quart	57.75
1 dry quart	67.201
1 liter	61

PROBLEMS

Refer to Tables 33, 34, and 35 in solving these problems.

1. How many cubic feet are there in a solid whose volume is 2592 cubic inches?

2. How many cubic yards are there in a solid whose volume is 63 cubic feet?

3. A contractor removed 107 cubic yards of earth from an excavation. How many cubic feet did he remove?

4. A stone monument occupies 32 cubic feet of space. What is the volume of the monument in cubic inches?

5. Each time you breathe, you exhale about 500 milliliters of used air.

a. About how many liters do you exhale?
b. About how many pints do you exhale?

6. Vessels in chemical laboratories are marked to show their capacity in terms of the metric system. A certain flask is marked 1500 ml.

a. How many liters does this flask hold?
b. About how many pints does it hold?

7. How many cubic inches are occupied by 1 pint of milk?

8. How many cubic inches are occupied by 1 pint of raspberries?

9. A water tank has a volume of 45 cubic feet. About how many gallons of water will it hold?

10. A gasoline can occupies a volume of 3168 cubic inches. About how many gallons of gasoline will it hold?

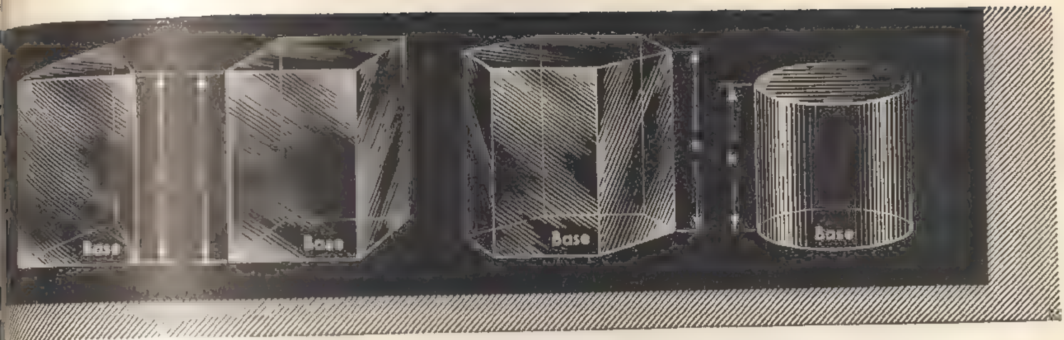


Figure 15–21

Volumes of Prisms and Cylinders

Each of the solids in Figure 15–21 has two parallel surfaces that are the same size and shape. One of these, on which the solid rests, is called the *base*. The perpendicular distance between them is the *height* of the solid. When the two surfaces are bounded by straight lines, the solid is called a *prism*. When the two surfaces are circles, the solid is called a *cylinder*. Examples of prisms are boxes and books; examples of cylinders are round pencils and tin cans. In Figure 15–21 there are three prisms and one cylinder. Notice that the side surfaces of the prisms are rectangles.

Figure 15–22

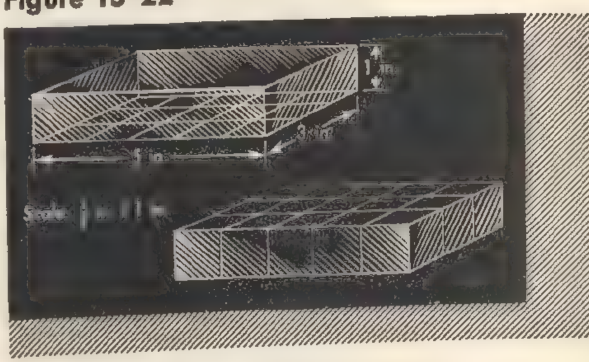


Figure 15–22 shows two views of a prism 1 inch in height. In the first view, you can see that the area of the base is 15 square inches. In the second view, you can see that this prism is made up of 15 one-inch cubes; that is, its volume is 15 cubic inches.

The prism in Figure 15–23 also has a base containing

Figure 15–23

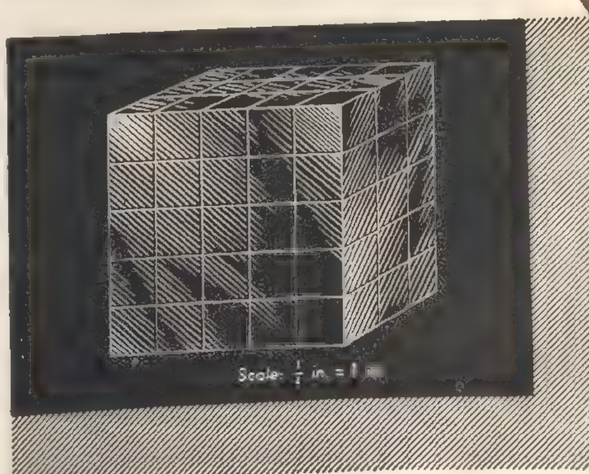


Figure 15–24

15 square inches. However, this prism is 5 inches high. You can think of it as being made up of 5 layers of one-inch cubes; each layer, of course, contains 15 cubes. This prism, then, contains 5×15 cubic inches, or 75 cubic inches.

The base of the cylinder in Figure 15–24 has a radius of $1\frac{3}{4}$ inches. Since the base is a circle, its area is equal to $\pi \times 1\frac{3}{4} \times 1\frac{3}{4}$, or $9\frac{5}{8}$ square inches. The height of the cylinder is 4 inches; so you can think of it as being made up of 4 one-inch slices, each having a base with an area of $9\frac{5}{8}$ square inches. The cylinder, then, contains $4 \times 9\frac{5}{8}$, or $38\frac{1}{2}$ cubic inches.

Do you see how to find the volume of a solid that has two parallel surfaces of the same size and shape? Multiply the number of units of area in the base by the number of units of length in the height.

Volume of a prism or cylinder	=	number of units of area in base	×	number of units in height	
V	=	B	×	h	
Volume of prism, Fig. 15–22	=	15	×	1	= 15 cu. in.
Volume of prism, Fig. 15–23	=	15	×	5	= 75 cu. in.
Volume of cylinder, Fig. 15–24	=	$9\frac{5}{8}$	×	4	= $38\frac{1}{2}$ cu. in.

PROBLEMS

In most of these problems, you will have to calculate the number of units of area in the base.

1. A nursery school block is in the shape of a cube 2 feet on a side. How much volume does it occupy?

2. A rectangular carton is 2 feet high and has a base 4 feet by $3\frac{1}{2}$ feet. How much volume does it occupy?

3. A cylindrical tin can is 3 inches high. Its base is 2 inches in diameter. What is the volume of the can in cubic inches?

4. A steel bar has a diameter of $1\frac{1}{2}$ inches and is 8 inches long. What is its volume?

5. One ton of coal takes up 32 cubic feet in a coal bin. The floor space in Mr. Clarke's coal bin is 5 feet wide and 8 feet long. How many tons of coal will it hold if he plans to fill the bin to a depth of 4 feet?

6. Mr. Blake wishes to estimate the number of bushels of grain he can store in a bin. If 1 bushel occupies $1\frac{1}{4}$ cubic feet, how many bushels can he store in a bin 6 feet by 8 feet by 10 feet?

7. Mr. Flynn estimates that a ton of ensilage will occupy 45 cubic feet in his silo. The silo has the shape of a cylinder whose diameter is 12 feet and height 30 feet. How many tons will the silo hold?

8. Mr. Meyers has a cylindrical gasoline can having a diameter of 12 inches and a height of $10\frac{1}{2}$ inches. How many gallons of gasoline will it hold?

9. Mr. Williams wishes to fill a circular flower bed with top soil to a depth of 18 inches. If the radius of the flower bed is 6 feet, how many cubic yards of top soil must he buy? (1 cu. yd. = 27 cu. ft.)

10. The radius of the bottom of a cylindrical tank is 1 foot. How deep must the tank be filled to contain 60 gallons of water? (1 cu. ft. = 7.5 gallons)

Volumes of Pyramids and Cones

Each of the solids in Figure 15–25, page 560, has a point (rather than a surface) opposite its base. A solid of this sort is called a *pyramid* when the base is bounded by straight lines; it is called a *cone* when the base is a circle. There are three pyramids and one cone in Figure 15–25.

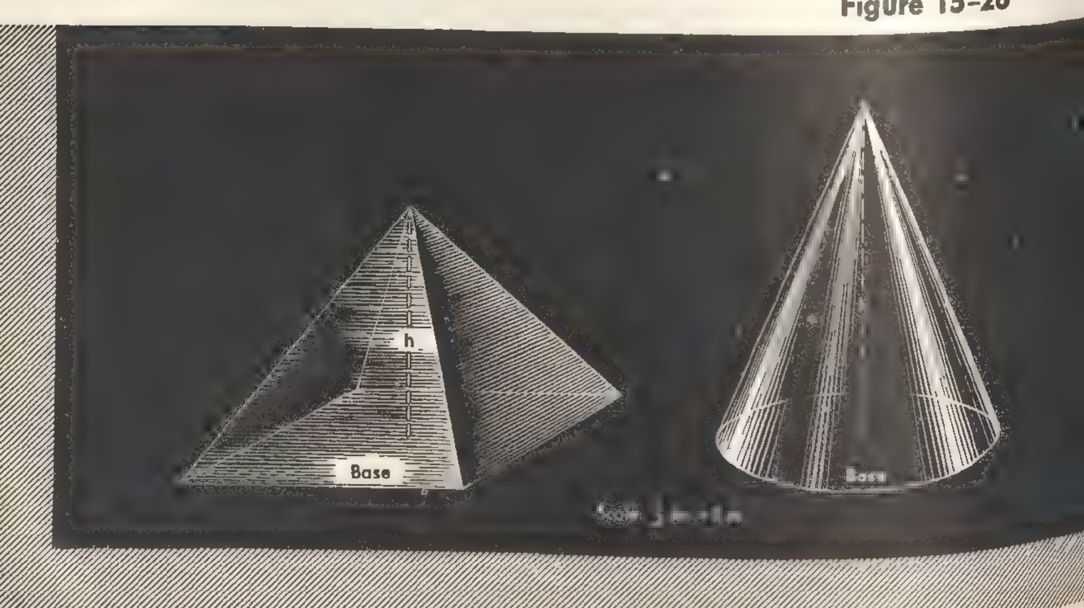
Figure 15–25

The point of a pyramid or a cone is called its *vertex*. The height of the solid is the shortest distance from the vertex to the base. See Figure 15–26.

Suppose you had a pyramid and a prism, each with the same base and height. You would not expect the pyramid to occupy the same space as the prism. As a matter of fact, its volume would be just one third the volume of the prism. Similarly, the volume of a cone is just one third the volume of a cylinder with the same base and height. See Figure 15–27.

Volume of a pyramid or cone	$= \frac{1}{3} \times$	number of units of area in base	$\times$	number of units in height		
V	$= \frac{1}{3} \times$	B	$\times$	h		
Volume of pyramid, Fig. 15–26	$= \frac{1}{3} \times$	36	$\times$	5	=	60 cu. in.
Volume of cone, Fig. 15–26	$= \frac{1}{3} \times$	$28\frac{2}{7}$	$\times$	7	=	66 cu. in.

Figure 15–26



PROBLEMS

In these problems, you will have to calculate the area of the base before finding the volume asked for.

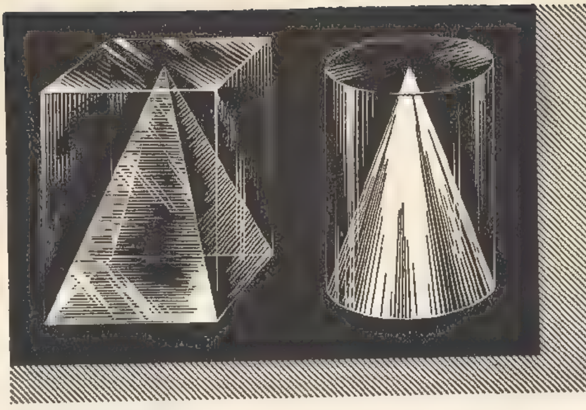


Figure 15–27

1. The base of a pyramid is a square, all of whose sides are 5 inches in length. The height of the pyramid is 9 inches. What is its volume?

2. One of the Egyptian pyramids was 212 feet in height when constructed. It had a square base, 354 feet on a side. How much space did it occupy?

3. A cone for ice cream is $2\frac{3}{4}$ inches in diameter and 7 inches long. What is its volume?

4. A cone-shaped paper cup is 3 inches in diameter and 4 inches long. How many cubic inches will it hold?

5. A coal dealer has a conical pile of coal and wishes to estimate the number of tons of coal in it. The diameter of the base is 12 feet and the pile is 10 feet high. Coal weighs approximately 60 pounds per cubic foot. Find to the nearest ton the number of tons of coal in the pile. (1 ton = 2000 pounds)

6. A grain hopper has the shape of a pyramid with a square base 3 feet on a side and is 4 feet deep. If a bushel of grain occupies $1\frac{1}{4}$ cubic feet, how many bushels will the hopper hold?

7. In a foundry metal is transferred by means of a ladle in the shape of a cone. If the metal weighs .25 pound per cubic inch, what is the weight of the metal in a ladle whose radius is 3 inches and depth 5 inches?

8. A can is made in the form of a cylinder with a conical top. The radius of the cone and of the cylinder is 6 inches, the height of the cylinder is 12 inches and the height of the cone is 5 inches. Approximately how many gallons will the can hold? (1 gallon = 231 cu. in.)

9. Mrs. Howard has a colander for draining liquids from fruit. It is in the shape of a funnel having a diameter of 6 inches and a height of 8 inches. How many pints of fruit will it hold? (1 pint is approximately 29 cu. in.)

10. Mr. Boyle wishes to estimate the number of truck loads of sand in a conical pile whose diameter is 9 feet and height 6 feet. If the truck will hold 27 cubic feet, approximately how many loads in the pile?

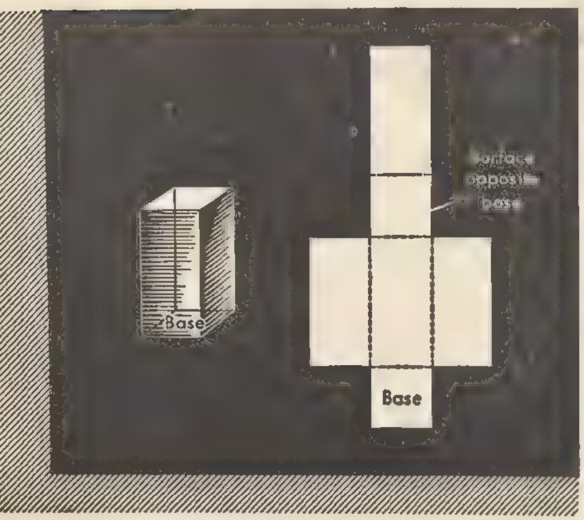


Figure 15–28

Some Surface Areas

Sometimes you need to know the total area of all the surfaces of a solid, or its *surface area*. When you make wood or metal objects such as boxes, lampshades, vases, and wastebaskets, you must lay out your work and determine the amount of material you need.

Figure 15–28 shows how the surfaces of a prism may be laid out as a single surface.

Surface area of a prism = Twice the area of the base + Sum of the areas of the sides

Figure 15–29 shows how the surfaces of a pyramid may be laid out as a single surface. You can see that the surface area of a pyramid is equal to the area of the base plus the sum of the areas of the sides.

Surface area of a pyramid = Area of the base + Sum of the areas of the sides

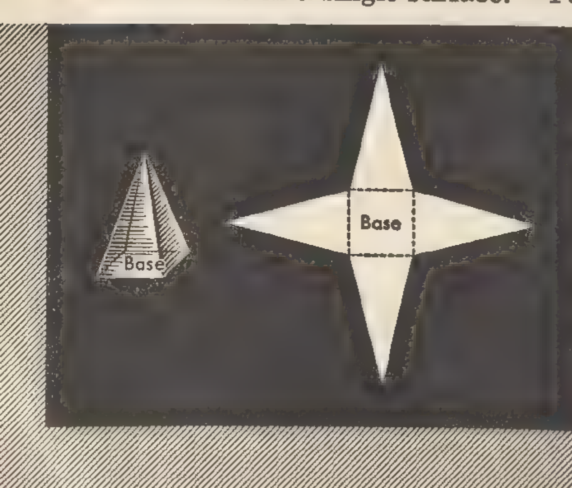


Figure 15–29

The sides of a pyramid are all triangles. When you find the area of one of these triangles, you must remember that the height of the triangle is *not* the same as the height of the pyramid itself. The height of a side is the perpendicular distance *along that side* from the vertex to the base. This distance is the *slant height* of the pyramid. See Figure 15–30.

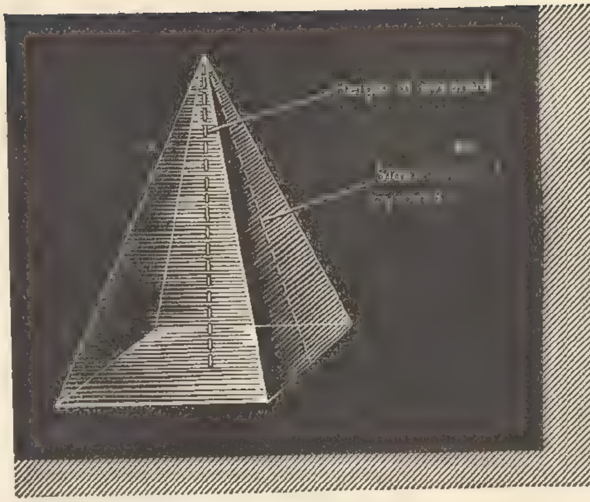
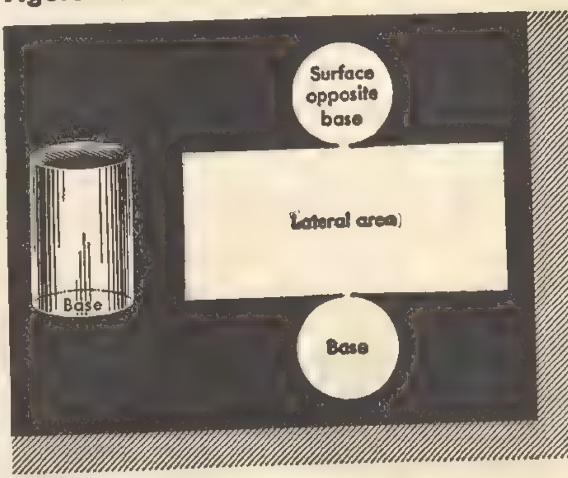


Figure 15–30

Next, consider the surface area of a cylinder. Figure 15–31 shows how to lay out a cylinder. Do you see that the side of a cylinder is a rectangle when it is unrolled? One dimension of the rectangle is the same length as the circumference of the circle that forms the base of the cylinder. The other dimension of the rectangle is the height of the cylinder. The product of these two lengths is the area of the rectangle. This area is called the *lateral area* of the cylinder.

Figure 15–31



Surface area of a cylinder = Twice the area of the base + Lateral area

Finally, consider the surface area of a cone. A cone, like a pyramid, has both a height and a slant height. (See Figure 15–32, page 564.) The slant height of a cone is the distance from the tip of the cone to the circumference of the base. You must know this distance in order to find the lateral area of a cone.

Figure 15–32

The lateral area of a cone is a section of a circle whose radius is the slant height of the cone. The curved line that is one boundary of the lateral area is the same length as the circumference of the base. These facts are shown in the pattern of a cone, Figure 15–33.

The lateral area of a cone is equal to half the product of the circumference of the base and the slant height.

$$\text{Lateral area of a cone} = \tfrac{1}{2} \times \begin{matrix}\text{circumference}\\ \text{of the base}\end{matrix} \times \begin{matrix}\text{slant height}\\ \text{of the cone}\end{matrix}$$

$$L = \tfrac{1}{2} \times C \times s$$

Since the circumference of a circle equals π times the diameter, or $2\,\pi$ times the radius (see page 551), you can find the lateral area in this way:

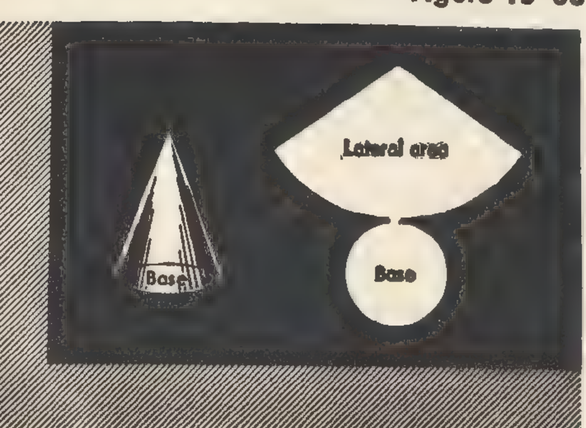
$$L = \tfrac{1}{2} \times 2\,\pi \times r \times s$$

$$L = \pi \times r \times s$$

When you have found the lateral area of a cone, you can easily find its surface area:

$$\text{Surface area of a cone} = \text{Area of base} + \text{Lateral area}$$

Figure 15–33



PROBLEMS

1. Using paper, cardboard, or any material you wish, construct a prism. Construct a pyramid having the same base as the prism. Let the slant height of the pyramid equal the height of the prism.

a. How does the height (not the slant height) of the pyramid compare with the height of the prism?

b. What is the surface area of your prism?

c. What is the surface area of your pyramid?

2. Make a model of a cylinder. Then construct a cone having the same base as the cylinder. Let the slant height of the cone equal the height (altitude) of the cylinder.

a. Which is longer, the height of the cone (not the slant height) or the height of the cylinder?

b. What is the surface area of the cylinder you constructed?

c. What is the surface area of the cone you constructed?

3. The roof of a house is a pyramid having a square base 28 feet on each side. The slant height is 17 feet. If 4 bundles of shingles will cover 100 square feet, how many bundles of shingles are needed to shingle the roof?

4. In building a cylindrical chimney a contractor estimates that he will use 15 bricks for each square foot of surface. How many bricks will he need for a chimney 30 feet high having a diameter of 5 feet? (Answer to the nearest 100 bricks.)

5. In making a funnel a circle having a radius of 4 inches was used. When the funnel was finished, its radius was 2 inches and its slant height 4 inches.

a. How many square inches are there in the circle from which the cone was made?

b. How many square inches are there in the cone?

Volumes and Surface Areas of Spheres

A baseball, an orange, and a soap bubble are all spheres like the one shown at the left in Figure 15–34. A sphere is a solid such that every point on its surface is the same distance from a certain point inside it, the center. A sphere has no base. You can describe a sphere accurately by giving either its radius or its diameter.

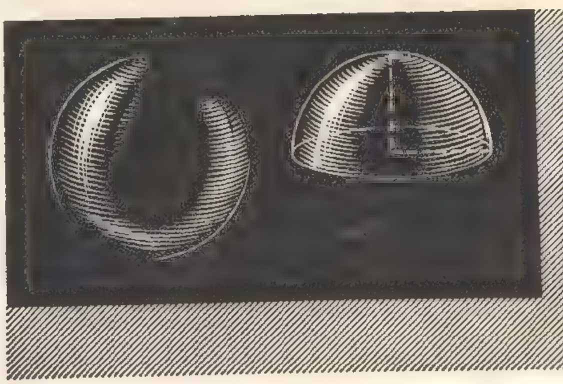


Figure 15–34

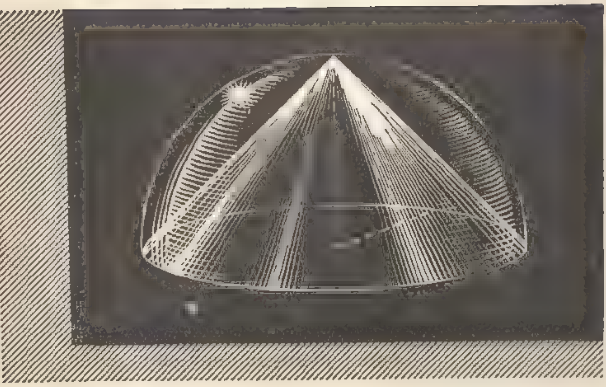


Figure 15–35

When a sphere is cut in half, each half is called a hemisphere. A hemisphere has a circular base. The height of the hemisphere is the same as the radius of the base.

Suppose you had a hemisphere and a cone, each with the same base and height. As Figure 15–35 shows, the volume of the hemisphere would be greater than the volume of the cone. Careful measurements have shown that the volume of a hemisphere is just twice the volume of a cone with the same base and height. You know that the volume of a cone is $\frac{1}{3}$ the product of its base and its height. The volume of a hemisphere, then, is $\frac{2}{3}$ the product of its base and its height. The base of a hemisphere is a circle; so the area of the base is equal to πr^2. The height of a hemisphere is the same length as its radius.

Volume of a hemisphere $= \frac{2}{3} \times B \times h$

Volume of a hemisphere $= \frac{2}{3} \times \pi \times r^2 \times r$

Since a hemisphere is half a sphere, a sphere with the same radius must have a volume just twice that of the hemisphere. (See Figure 15–36, page 567.) That is:

Volume of a sphere $= 2 \times \frac{2}{3} \times \pi \times r^2 \times r$

The product $2 \times \frac{2}{3} \times \pi$ is usually written $\frac{4}{3}\pi$, and the product $r^2 \times r$ is usually written r^3. (Read: "r to the third power," or "r-cubed.")

Volume of a sphere $= \frac{4}{3}\pi \times$ number of units in radius, cubed

$V = \frac{4}{3}\pi \times r^3$ or $V = \frac{4}{3}\pi r^3$

Volume of sphere in Fig. 15–36 $= \frac{4}{3} \times \frac{22}{7} \times 5 \times 5 \times 5 = 523\frac{17}{21}$ cu. in.

The surface area of a sphere is equal to four times the area of a circle with the same radius; that is, it equals $4\pi r^2$. Since a sphere can never be completely flattened out, it is hard to show this relationship accurately. There are several ways to show it approximately, however. One way is to take the casing off a ball and compare its area with the area of four circles each having the same diameter as the ball.

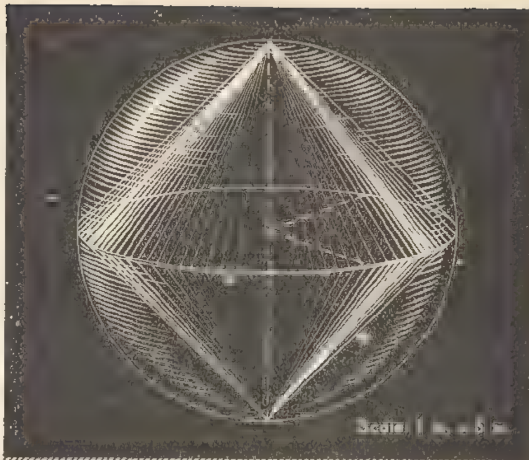
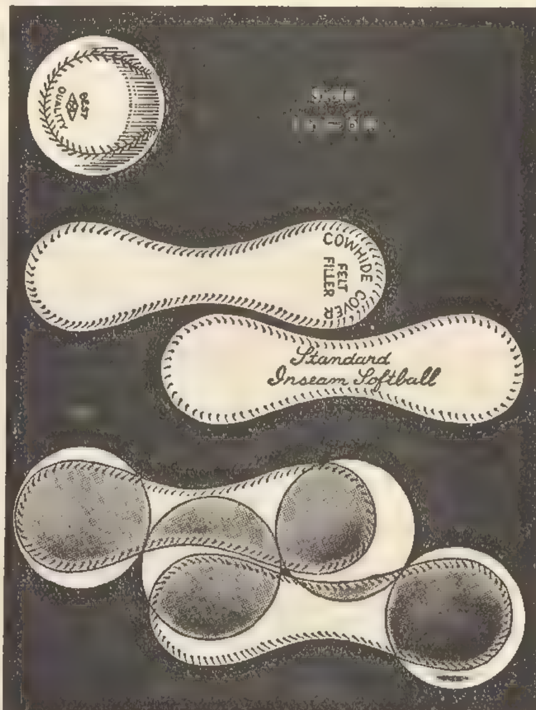


Figure 15–36

Figure 15–37 shows a softball with a radius of $1\frac{3}{4}$ inches. Beneath the picture of the ball is a scale drawing of the two pieces that make up its casing. The third sketch shows four circles, each with a radius of $1\frac{3}{4}$ inches, laid on the pieces of the casing. The areas of the circles are about the same as the total area of the casing. Some parts of the casing are not covered by the circles. Their area is just about equal to that of the unshaded parts of the circles.

Figure 15–37



Surface area of a sphere = 4 × π × radius multiplied by itself

$$S = 4 \times \pi \times r^2$$

Surface area of Fig. 15–37 $= 4 \times \frac{22}{7} \times \frac{7}{4} \times \frac{7}{4}$

$$= 38\frac{1}{2} \text{ sq. in.}$$

PROBLEMS

1. Find the volume and the surface area of spheres with diameters as follows:

- **a.** 4 inches
- **b.** 8 inches
- **c.** 12 inches
- **d.** 3 feet
- **e.** 4 feet

2. How many square inches of copper are in a spherical float whose radius is 2 inches?

3. A spherical gas storage tank has a radius of 60 feet. What is the volume of the tank?

4. A large kettle is a hemisphere whose radius is 1 foot. How many gallons will the kettle hold? (1 cu. ft. = 7.5 gallons)

5. Part of an ornament in a park is a cast-iron sphere having a diameter of 8 inches. What is the weight of the sphere if cast iron weighs .26 pound per cubic inch?

Although you can tell that this picture is a photograph of a model, not of a real scene, you have no idea of the scale of the model until you look at the picture facing it on page 569.

INTERNATIO

What You Have Learned in This Chapter

1. Some relations among various units of length, area, volume, and capacity
2. How to measure lengths accurately
3. How to make and read scale drawings
4. Using only straightedge and compass, to construct perpendicular lines, acute and obtuse angles, and parallel lines
5. How to find areas:

   Area of any parallelogram $= b \times h$
   Area of any triangle $= \frac{1}{2} b \times h$
   Area of any circle $= \pi r^2$
   Lateral area of any cone $= \pi r \times s$
   Surface area of any sphere $= 4\,\pi r^2$

6. How to find volumes:

   Volume of prism or cylinder $= B \times h$
   Volume of pyramid or cone $= \frac{1}{3} B \times h$
   Volume of sphere $= \frac{4}{3} \pi r^3$

7. The meaning of these terms: *metric system, perpendicular lines, parallel lines, arc, bisect, obtuse angle, acute angle, vertex, prism, pyramid, slant height, lateral area*

Review Test on Geometry

For this test you will need ruler and compass.

1. Measure the length of this line:

a. Report your measurements in a form that will show that you tried to be as accurate as possible.

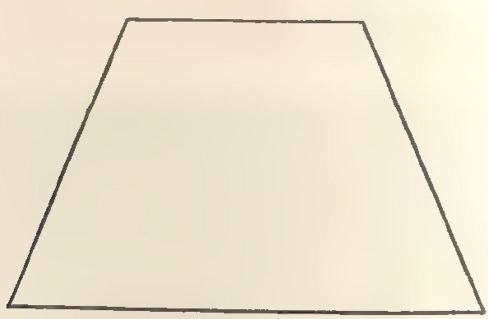
b. Report the length of the line in metric units. (1 in. = 2.54 cm.)

2. Draw a rectangle to represent a garden 32 feet long and 16 feet wide. Be sure to indicate the scale of your drawing.

3. Draw any triangle. Using your compass but not your protractor, draw a perpendicular line from the vertex of the triangle to its base.

4. Draw any vertical line. Using your compass, construct another line parallel to it.

5. Find the area of the figure drawn to scale below.



Scale $\frac{1}{2}$ In. = 2 Ft.

6. A cylindrical can is 9 inches high and has a radius of 5 inches.

a. What is the surface area of the can?

b. How many cubic inches of space will the can occupy?

c. What is the capacity of the can? (1 gal. = 231 cu. in.)

d. How many liters of liquid will the can hold? (1 liter = 61 cu. in.)

7. Cast iron weighs .26 pound per cubic inch. A rectangular bar of cast iron is $3\frac{1}{2}$ inches wide, 2 inches thick, and $8\frac{1}{2}$ inches long.

a. What is the volume of the bar?

b. How much does the bar weigh?

8. A tent is made in the form of a pyramid with a square base 8 feet on each side. The slant height of the tent is 9 feet. How many square yards of canvas were required to make the tent?

9. A cone-shaped funnel is 8 inches deep. The diameter of the mouth (base) is 6 inches. How many cubic inches of liquid will the funnel hold?

10. A trophy is in the shape of a basketball. Its diameter is 12 inches.

a. What is its volume?

b. What is its surface area?

How do you rate?	Excellent	Good	Fair	Poor
	9–10	8	6–7	5 or less

CHAPTER 16

ROBERTS

Just as,
when we learn to drive a car
we are able to "go places"
easily and pleasantly
instead of walking to them
with a great deal of effort,
And so you will see that
the more Mathematics we know
the EASIER life becomes,
for it is a TOOL with which
we can accomplish things
that we could not do at all
with our bare hands.

H. G. and L. R. Lieber, *The Education of T. C. Mits*, W. W. Norton, 1944

ALGEBRA

GENERAL METHODS OF PROBLEM SOLVING

WHEN YOU SOLVE problems by means of arithmetic, you add, subtract, multiply, and divide figures. The figures refer to quantities: 5 men, 8 chairs, 20 dollars, 35 miles, and so on. When you solve problems by means of algebra, you use both figures and letters to refer to quantities. You add, subtract, multiply, and divide letters as well as figures. You can, therefore, solve problems in a general way, even though you do not know specifically what quantities are involved.

Using a Letter to Mean "A Certain Quantity"

Imagine a jar that seems to be full of tacks. You do not know how many tacks are in the jar, but you know that it contains a certain number of tacks. So you say that there are n tacks in the jar. If you prefer, you may say that there are x tacks in the jar. You may, in fact, select any letter you wish to mean "a certain quantity."

Suppose that a jar of nails is next to the jar of tacks. The number of nails is probably different from the number of tacks; so you use a different letter — m, perhaps, or y.

If you had n tacks, and found three more on the work bench,

you would have $n + 3$ tacks. If your jar of nails contained m nails, and you used six of them, you would have $m - 6$ nails left.

Or you might have a second jar of nails, equally full. Then you would have $2 \times m$ nails. (It is correct to omit the multiplication sign and write merely $2m$.)

If you poured out half your tacks, you would be dividing by 2. You can express this fact in these ways:

$$n \div 2 \qquad \tfrac{1}{2}n \qquad \frac{n}{2}$$

Working with Letters and Figures

Addition, subtraction, multiplication, and division are similar operations, whether you carry them out with figures only, or with figures and letters, or with letters only.

Here are some examples in which only letters are used.

Addition: If the number of men in a room is x and the number of women is y, the total number in the room is $x + y$.

Subtraction: Let t represent the number of students in a class. If u students are unprepared, the number of students who are prepared is $t - u$.

Multiplication: Let d be the distance from your house to your school. Then n times the distance is $n \times d$ or nd. (When two letters, or a letter and a number, have no sign between them the multiplication sign is understood.)

Division: Let c be a cake, which you divide into s slices. Then the size of each slice is $\frac{c}{s}$.

PRACTICE

1. Andrew went shopping and spent seven dollars. If he had a dollars when he started out, how much did he have left?

2. If there are b books on your bookshelf, and you remove three books, how many books remain on the shelf?

3. The attendance at today's game was 53 more than the attendance at the game a week ago.

a. Represent the number attending the game last week.
b. How many people attended today's game?

4. The State highway department took a census of the number of cars passing a certain intersection. On Saturday 743 more cars were counted than on Friday.

a. Represent the number of cars counted on Friday.
b. How many cars were counted on Saturday?

5. If gasoline costs n cents per gallon, what is the cost of 12 gallons?

6. If textbooks cost n dollars each, what is the cost of textbooks for a class of 32 students?

7. Dorsetville is exactly halfway between Wheatfield and Brookford. How far from Brookford is Dorsetville? (*Hint:* Select a letter to represent the distance between Wheatfield and Brookford.)

8. Susan divides all the money she earns into five equal parts. One of these parts she saves. How much money does she save? (*Hint:* Select a letter to represent the total amount Susan earns.)

9. Mr. and Mrs. Johnson both have jobs. Mr. Johnson's monthly income is greater than Mrs. Johnson's. Let k stand for Mr. Johnson's monthly income, and let l stand for Mrs. Johnson's monthly income.

a. How much is the Johnsons' combined monthly income?
b. How much more does Mr. Johnson earn than Mrs. Johnson each month?
c. What is Mr. Johnson's annual income?

10. Let x stand for the number of years that Franklin Roosevelt was President of the United States, and let y stand for the number of years of Harry Truman's terms.

a. How long were the combined terms of Presidents Roosevelt and Truman?
b. How many more years did President Roosevelt serve than President Truman?
c. How many months did President Roosevelt serve?

"A Certain Quantity" in an Equation

An *equation* is a statement that one thing equals something else. Here is an equation: $a + 5 = 12$. It is read this way:

"A certain quantity plus five equals twelve." What *figure* represents "a certain quantity"? It must be 7, because $7 + 5 = 12$. Therefore $a = 7$.

In an equation the expression on the left side of the equal sign (called the *left member*) has the same value as the expression on the right side of the equal sign (called the *right member*). When you have an equation in which there is only one letter, you can find the figure which represents the value of that letter. First put the equation into words; then substitute the correct figure for "a certain quantity."

PRACTICE

In exercises 1 through 10, tell whether or not the expression is an equation.

1) $z - 7 = 2$

2) $5 = h + 3$

3) $d = 4$

4) $a + 8$

5) $b + c$

6) $s = 24$

7) $a + b = b + a$

8) $2 + m = 5$

9) $3c + 2 = 9 + 2$

10) $c + 8 = 15$

Put items 11 through 18 into words.

11) $e - 9 = 3$

12) $2g = 10$

13) $\frac{1}{2}m = 4$

14) $9 = 2 + k$

15) $7 = x - 3$

16) $12 = 4y$

17) $6 = z \div 4$

18) $2r + 1 = 13$

In exercises 19 through 30, give the value of "a certain quantity."

19) $2 + x = 3$

20) $5 + y = 8$

21) $z + 2 = 6$

22) $r + 1 = 11$

23) $15 + s = 20$

24) $12 = 9 + d$

25) $9 = 4 + e$

26) $20 = f + 5$

27) $7 = m + 3$

28) $17 = w + 7$

29) $a + 3 = 5 + 3$

30) $b + 3 = 6 + 2$

Tell what figure correctly represents each letter in the following equations.

31) $c - 3 = 7$
32) $4 = p - 2$
33) $2 = q - 4$
34) $4 - x = 2$
35) $25 - g = 20$
36) $10 - n = 7$
37) $9 = 12 - b$
38) $8 = 10 - y$
39) $h - 3 = 10$
40) $m - 3 = 6$
41) $1 = c - 3$
42) $15 = r - 5$
43) $7 = z - 8$
44) $c - 4 = 10 - 4$
45) $s - 4 = 11 - 5$
46) $t - 4 = 12 - 6$
47) $a - 1 = 2 + 3$
48) $k - 2 = 4 + 6$

Find the value of the letters in the following equations.

49) $e \times 4 = 8$
50) $g \times 5 = 25$
51) $5 \times i = 50$
52) $6 \times f = 18$
53) $4 \times m = 20$
54) $24 = n \times 6$
55) $16 = s \times 2$
56) $6 = t \times 3$
57) $12 = 3 \times a$
58) $14 = 7 \times c$
59) $2r = 12$
60) $5n = 10$
61) $2w = 6$
62) $12 = 4b$
63) $15 = 5x$
64) $\frac{1}{2}x = 5$
65) $\frac{1}{2}z = 7$
66) $\frac{1}{4}d = 2$
67) $\frac{1}{4}f = 3$
68) $\frac{1}{3}p = 3$
69) $6 = \frac{1}{3}q$
70) $2 = \frac{1}{5}y$
71) $a \div 3 = 7$
72) $e \div 2 = 4$
73) $g \div 2 = 25$
74) $\frac{n}{3} = 5$
75) $\frac{h}{2} = 1$

Forming Equations

Equations are useful in solving problems. Many times you will have a problem to solve which tells you that one thing is equal to something else, or that tells you the same fact in two ways. If you can form an equation, using a letter to indicate the quantity whose value you do not know, you can solve the problem.

The example that follows is very simple. You can solve it mentally. But study it anyway, for it will help you understand harder problems to come.

Example Today James received 5 dollars. He now has 33 dollars. How much did he have yesterday?

What to Do	How to Do It
(1) Use a letter to indicate the quantity whose value you do not know.	Amount James had yesterday = a
(2) Find some fact that is given in two different ways.	Amount James has now is \$33. It is also \$5 more than he had yesterday; or $5 + a$
(3) Write an equation stating this fact.	$33 = 5 + a$
(4) Find the value of the letter in the equation.	$a = 28$ Answer

PRACTICE

Write an equation for each of the following problems. You need not find the answer.

1. When Northside High played Memorial High in basketball, the bleachers, which hold 425 persons, were filled to capacity. Some fans had season tickets; others bought their tickets at the door. If 120 tickets were sold at the door, how many season-ticket holders attended the game?

2. The League of Future Voters of Campbell High School sponsored an open meeting addressed by candidates for the town officers. The count showed that 186 persons entered the auditorium. However, 34 persons left early. How many persons remained until the meeting ended?

3. Bob earned twice as much money Saturday as Paul did. If Bob earned $3.80, how much did Paul earn?

4. Mrs. Jones's bill for milk alone last week was $5.04. If milk is 24 cents per quart, how much milk did she buy?

INTERNATIONAL

When you weigh a substance, you make sure that the weight in one scale pan is equal to the weight in the other. When you form an equation, you make sure that the quantity in one member ***is*** *equal to the quantity in the other.*

5. On a mathematics test, Jane did only two thirds of the problems correctly. If she had 8 problems correct, of how many problems did the test consist?

6. The gasoline tank of Mr. Sampson's car was entirely empty. He had ten gallons of gasoline put into it. If it was then four fifths full, how many gallons does the tank hold?

7. John drove 39 miles from his home to his aunt's. He then took his aunt to the market and back. The mileage on the car was then 43 miles more than when John left home. How far is it from his aunt's house to the market?

8. Harry cut three lengths from a board 45 inches long. One piece was 23 inches long. If the other two pieces were equal in length, how long was each?

9. Bill had three fifths of his mathematics problems correct. Jim had 4 more right than Bill had. If Jim did 16 problems correctly, how many problems were there?

10. Betty is 5 years younger than her sister Caroline, and Caroline is half as old as their mother. If Betty is 15, how old is her mother?

Using Equations

Think of an equation as a balance, like the scales in Figure 16–1. Notice that the drawing shows a five-pound box of sugar on one scale pan, and a five-pound weight on the other scale pan. The scale pans balance. If you let s stand for the weight of the sugar, you can show the situation by this equation: $5 = s$.

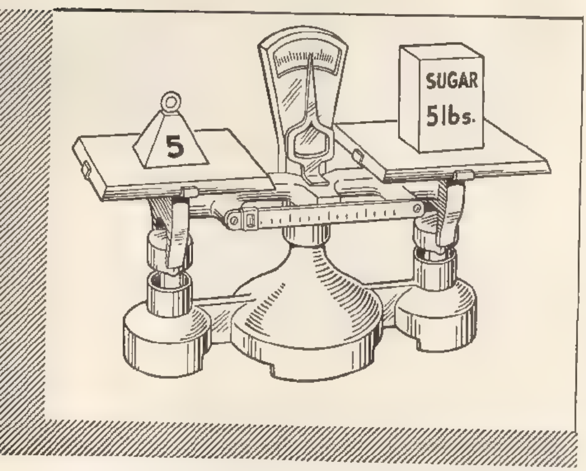


Figure 16–1

To keep the scales in balance, you must treat each scale pan in the same way. If you add a pound to one scale pan, you must add a pound to the other scale pan, also: $5 + 1 = s + 1$. If you take off a pound from one scale pan, you must take off a pound from the other scale pan: $5 - 1 = s - 1$. If you double the amount in one scale pan, you must double the amount in the other scale pan: $2 \times 5 = 2s$. If you take away half the quantity in one scale pan, you must take away half the quantity in the other scale pan: $\frac{1}{2} \times 5 = \frac{1}{2} \times s$.

Solving Simple Equations

Solving an equation is like keeping scales in balance.

(1) If you add a quantity to one side of an equation, you must add the same quantity to the other side.

(2) If you subtract a quantity from one side of an equation, you must subtract the same quantity from the other side.

(3) If you multiply one member by some number, you must multiply the other member by the same number.

(4) If you divide one member by a number, you must divide the other member by the same number.

Here are some examples:

Equation	What to Do	How to Do It
$n - 2.8 = 1.7$	*Add* 2.8 to both members	$n - 2.8 = 1.7$ $+ 2.8 \quad + 2.8$ $n = 4.5$
$r + 2.1 = 3.4$	*Subtract* 2.1 from both members	$r + 2.1 = 3.4$ $- 2.1 \quad - 2.1$ $r = 1.3$
$\frac{1}{4}x = 5$	*Multiply* both members by 4	$4 \times \frac{1}{4}x = 4 \times 5$ $x = 20$
$3y = 240$	*Divide* both members by 3	$3y \div 3 = 240 \div 3$ $y = 80$

PRACTICE

Tell what process you would use to solve each equation.

1) $a - 3 = 7$
2) $b - 2.4 = 1.6$
3) $5 = c - 2.1$
4) $7 = d - 4$
5) $8 = e + 1$
6) $42 = f + 23$
7) $c + 1.7 = 6.3$
8) $h + 29.1 = 57$
9) $i - 171 = 22$
10) $j + 14 = 128$
11) $\frac{1}{2}k = 17$
12) $\frac{1}{8}l = 2$
13) $\frac{2}{3} = \frac{1}{3}m$
14) $\frac{3}{4} = \frac{n}{4}$
15) $28 = 2p$
16) $150 = 5q$
17) $3.2r = 6.4$
18) $\frac{s}{16} = 3$
19) $6t = 7.2$
20) $3.14u = 62.8$

Solve the following equations by addition.

21) $x - 3 = 12$
22) $n - 6 = 11$
23) $21 = y - 4$
24) $14 = r - 12$
25) $4 = x - 7$
26) $P - 3.5 = 5.5$
27) $n - 2.4 = 3.6$
28) $x - 4.8 = 6.4$
29) $r - \frac{1}{2} = 3\frac{1}{2}$
30) $x - 2\frac{3}{4} = 3\frac{1}{4}$
31) $10 = x - 5$
32) $19 = N - 4$
33) $26 = x - 10$
34) $r - \frac{2}{3} = 3\frac{2}{3}$
35) $10\frac{1}{2} = n - 6\frac{1}{2}$
36) $1.56 = p - 3.12$
37) $x - \frac{1}{2} = \frac{3}{4}$
38) $x - \frac{2}{3} = \frac{5}{6}$
39) $W - 4.12 = 5.47$
40) $R - .76 = 4.12$

Solve the following equations by subtraction.

41) $n + 3 = 11$
42) $x + 6 = 11$
43) $12 = P + 5$
44) $15 = r + 8$
45) $7 + N = 15$
46) $5 + q = 16$
47) $21 = 6 + p$
48) $6.5 = n + 3.2$
49) $R + 7.5 = 12.8$
50) $.75 = x + .36$
51) $z + 12\frac{1}{2} = 27$
52) $m + 7.9 = 16.2$
53) $p + 7\frac{1}{3} = 15\frac{2}{3}$
54) $25 = x + 5$
55) $17\frac{1}{2} = W + 7\frac{1}{2}$
56) $12 = P + 8$
57) $16 = u + 7$
58) $t + 5\frac{1}{4} = 16\frac{7}{8}$
59) $m + 2\frac{3}{4} = 6\frac{1}{4}$
60) $x + .57 = 2.12$

Solve the following equations by multiplication.

61) $\frac{1}{2}a = 5$

62) $\frac{1}{8}L = 7$

63) $\frac{1}{11}b = 15$

64) $3 = \frac{1}{14}s$

65) $4.5 = \frac{1}{6}x$

66) $\frac{y}{3} = 5\frac{1}{3}$

67) $\frac{D}{2} = 3.4$

68) $\frac{v}{4} = 7.5$

69) $4.3 = \frac{s}{10}$

70) $3 = \frac{x}{18}$

71) $\frac{P}{5} = 3\frac{1}{2}$

72) $\frac{w}{4} = 4\frac{1}{4}$

73) $\frac{n}{7} = 17$

74) $\frac{y}{8} = 7.06$

75) $\frac{V}{9} = 8.34$

76) $8.76 = \frac{n}{10}$

77) $9.34 = \frac{1}{5}x$

78) $3.75 = \frac{1}{6}N$

79) $\frac{1}{12}x = 12\frac{1}{4}$

80) $\frac{1}{20}t = 6\frac{1}{2}$

Solve the following equations by division.

81) $3n = 15$

82) $4w = 16$

83) $10 = 8n$

84) $2 = 6x$

85) $3s = \frac{6}{10}$

86) $3\frac{1}{2}x = 7$

87) $2r = 7\frac{2}{3}$

88) $1\frac{1}{2}n = 12$

89) $3\frac{3}{4} = 3x$

90) $10\frac{5}{6} = 5n$

91) $2\frac{1}{2}r = 10$

92) $5N = 7.5$

93) $22 = 3\frac{1}{7}r$

94) $2.4 = .2x$

95) $3 = 4\frac{1}{2}y$

96) $.5s = 4$

97) $10R = 2$

98) $2\frac{1}{2}n = 7\frac{1}{2}$

99) $9.6 = 2.4x$

100) $3.25 = 5n$

Solving More Difficult Equations

So far you have needed to use only one process in solving an equation. But some equations can be solved only by taking two or more steps. You may have to use both addition and division. You may have to use both addition and multiplication. Or perhaps you may need to subtract and divide, or to subtract and multiply. Here are some examples:

Addition and Division	$5x - 3 = 22$
First do the addition:	$5x = 25$
Then do the division:	$x = 5$
Addition and Multiplication	$\frac{t}{8} - 4 = 2$
First do the addition:	$\frac{t}{8} = 6$
Then do the multiplication:	$t = 48$
Subtraction and Division	$3m + 6 = 27$
First do the subtraction:	$3m = 21$
Then do the division:	$m = 7$
Subtraction and Multiplication	$\frac{s}{5} + 1 = 8$
First do the subtraction:	$\frac{s}{5} = 7$
Then do the multiplication:	$s = 35$

PRACTICE

Solve the following equations by using addition and division.

1) $3x - 2 = 28$

2) $6n - 3 = 15$

3) $62 = 8n - 10$

4) $14 = 3r - 1$

5) $1.5y - 15 = 0$

6) $11x - 5 = 28$

7) $80 = 5y - 5$

8) $.7z - .3 = 1.1$

9) $75b - 10 = 5$

10) $9c - 3 = 6$

Solve the following by using addition and multiplication.

11) $\frac{x}{10} - 12 = 8$

12) $\frac{t}{5} - 3 = 2$

13) $5 = \frac{r}{8} - 7$

14) $2 = \frac{T}{16} - 4$

15) $\frac{m}{5} - 3 = 2.6$

16) $\frac{1}{2}u - 3.4 = 1.7$

17) $\frac{1}{7}s - 19 = 1$

18) $\frac{1}{4}m - 8.2 = 3.0$

19) $75 = \frac{1}{32}H - 15$

20) $\frac{1}{64}i - \frac{3}{8} = \frac{5}{8}$

Use subtraction and division to solve the following equations.

21) $4n + 7 = 47$

22) $5r + 2 = 17$

23) $24 = 7n + 3$

24) $31 = 2x + 15$

25) $2.4m + .34 = 5.14$

26) $7x + .3 = 2.4$

27) $6a + 1.7 = 16.7$

28) $12.3 = 15k + .3$

29) $4w + 3 = 5$

30) $8z + 7 = 9$

Use subtraction and multiplication to solve the following equations.

31) $\frac{y}{6} + 6 = 15$

32) $\frac{p}{8} + 9 = 10$

33) $8 = \frac{W}{16} + 3$

34) $\frac{1}{2}x + 5 = 11$

35) $\frac{n}{3} + 4.6 = 9.6$

36) $8 = \frac{1}{4}f + 5$

37) $\frac{y}{3} + .6 = 12.6$

38) $\frac{k}{10} + .3 = 1.1$

39) $\frac{u}{4} + \frac{3}{8} = \frac{7}{8}$

40) $\frac{w}{8} + \frac{1}{4} = 1\frac{3}{4}$

Decide what steps you would take to solve each of these equations; then solve it.

41) $3A + 15 = 165$

42) $2b - 2 = 18$

43) $20 = 2c + 8$

44) $\frac{1}{7}D + 3 = 16$

45) $\frac{e}{3} - 8 = 6$

46) $\frac{2}{3}f = 6$

47) $\frac{3}{5}G + 2 = 11$

48) $\frac{5}{8}H - 7 = 3$

49) $2i - 8 = 0$

50) $9.1 = .5J - .4$

How to Use Equations to Solve Problems

Some problems are easier to solve by equations than by any other means. The first step is to let a letter stand for the quantity you want to find. The second step is to express other quantities in terms of this letter. Then find some fact that is given in two different ways, and write it as an equation. Solve the equation, and the problem is solved.

Example

In a class of 33 members, there are three more girls than boys. How many boys are there in the class?

What to Do	How to Do It
(1) Let a letter stand for the quantity you want to find.	Number of boys = n
(2) Express other quantities in terms of this letter.	Number of girls = $n + 3$
(3) Find some fact that is given in two different ways.	Number of class members is 33. It is also the number of boys plus the number of girls, or $n + n + 3$
(4) Write an equation stating this fact.	$33 = n + n + 3$ $33 = 2n + 3$
(5) Solve the equation.	$33 = 2n + 3$ $-3 \quad -3$ $30 = 2n$ $30 \div 2 = 2n \div 2$ $15 = n$ Answer

PROBLEMS

For each of these problems, write an equation and solve it.

1. A total of 381 people attended the afternoon performance of the Hidrama Club play. There were 113 more stu-

dents than adults present. How many adults were at the performance?

2. Twenty-three people were present at a party. The number of men was seven more than the number of women. How many women were at the party?

3. Peggy and Beth earned a net profit of $51 selling candy. Since Beth did twice as much of the work as Peggy did, they agreed that she was to receive twice as much money. How much money did each girl receive?

4. Henry and Sam worked together mowing lawns one summer. Sam did three times as much work as Henry, and received three times as much money. Together the boys earned $84. How much did each boy receive?

5. Divide $60 into two parts. One part is to be three times the other.

6. Divide $60 into two parts. One part is to be four times the other.

7. A farmer divided 280 acres between wheat and corn. He had 30 acres fewer of corn than of wheat. How many acres of wheat did he have?

8. Mr. Pearce drove 382 miles last Friday. His mileage before stopping for lunch was 96 miles less than his mileage after lunch. How many miles did he drive after lunch?

9. Jean had $7 less than half as much money as her brother Bill. If she had $14, how much money did Bill have?

10. One season a certain player in the American League was at bat 16 times less than half as often as one of his teammates. If he was at bat 256 times, how many times was his teammate at bat?

How Letters Are Used in Formulas

You are familiar with the interest formula (see Chapter 8, pages 294–295) and with formulas for areas and volumes (see Chapter 15, pages 542–568). You know that a formula is a brief statement of a general rule. Do you see that it is an

equation? In a formula, several values are expressed in letters rather than in figures. In some formulas, figures as well as letters are used.

You can see the relationship between a rule and a formula from this example:

Rule: The net cost is the marked price less the discount.

Formula: $c \quad = \quad p \quad - \quad d$

Making and Applying Formulas

Any rule used in mathematics can be expressed as a formula by following three steps:

(1) Decide what are the important words in the rule.

(2) Select a letter for each value not given in figures.

(3) Write an equation that has the same meaning as the rule.

The letters selected are often the first letters of important words in the rule, but any other letters will do as well. The letters in formulas refer to quantities, just as do the letters in other equations.

Since a formula is an equation, you will always need to use an equal sign. If the rule states that quantities are to be added or subtracted, you must use plus and minus signs. But if the rule states that quantities are to be multiplied or divided, you need not use the signs for these operations. (See page 574.)

Sometimes you need to use *exponents.* An exponent is a small number which shows that a quantity is to be multiplied by itself, perhaps several times. For example, the area of a square is equal to the length of the side of the square multiplied by itself. That is, $A = s \times s$. Instead of writing ss, write s^2. The volume of a cube is equal to the length of one side multiplied by itself and then multiplied again by itself. That is, $V = s \times s \times s$. Instead of writing sss, write s^3.

It is useful to know how to make a formula from a rule. For example, a man wants to order bricks to build a wall. He learns that it takes 21 bricks (as well as mortar) to

build 1 cubic foot of brick wall. That is, the number of bricks he needs is 21 times the number of cubic feet in the wall he intends to build. The number of cubic feet in the wall is the product of the length of the wall, its thickness (or width), and its height. He can therefore state this rule: The number of bricks needed is 21 times the product of the length times the width times the height of the wall. Or he can write the statement as a formula: $n = 21\ lwh$.

GALLOWAY

Each cubic foot of brick wall contains 21 bricks; therefore $n = 21\ lwh$.

PROBLEMS

1. The perimeter of a triangle (distance around the sides) is equal to the sum of the lengths of the sides.

a. Call the lengths of the sides a, b, and c, and write a formula for the perimeter of a triangle.

b. What is the perimeter of a triangle if $a = 4$ inches, $b = 5$ inches, and $c = 6$ inches?

c. A triangle has a perimeter of 12 inches. One side is 3 inches long, and another is 4 inches long. How long is the third side?

d. An isosceles triangle is a triangle in which two of the sides are of the same length. Use s to indicate the length of the equal sides of an isosceles triangle and t to indicate the length of the third side of the triangle. Write a formula for the perimeter of an isosceles triangle.

e. How long are the equal sides of an isosceles triangle if the perimeter is 7 inches and the third side is 3 inches long?

2. The perimeter of a rectangle is equal to twice the length of the rectangle plus twice the width of the rectangle.

GALLOWAY

Formulas are used by those responsible for loading airplanes to determine what weight may be put in the cargo compartment.

a. Call the length of the rectangle l and the width w. Write a formula for the perimeter of a rectangle.

b. If a rectangle is 6 feet long and 2 feet wide, what is its perimeter?

c. A rectangle has a perimeter of 42 feet. Its width is 9 feet. How long is it?

d. A square is a rectangle in which the length is equal to the width. Use s to indicate the side of a square, and write a formula for the perimeter of a square.

e. What is the length of the side of a square whose perimeter is 48 feet?

3. The amount of interest due on a loan is the product of the amount of the loan, the rate of interest, and the length of time for which the loan is given.

a. Select a letter to stand for each value not given. Tell the meaning of each letter you select.

b. Write a formula by which you can find the amount of interest due on a loan.

c. How much is the interest on a $10,000 loan if the rate of interest is 5 per cent and the money is borrowed for 2 years?

d. The interest on a $5000 loan that ran for 3 years was $900. What rate of interest was charged?

e. If a man paid $60 interest on a loan of $500 at 12 per cent per year, how long did he have the money?

4. The safe working strength of a leather belt in pounds is 300 times the product of its width and thickness (both in inches).

a. Select a letter to stand for each value not given in the rule. Tell the meaning of each letter you select.

b. Write a formula by which you can determine the safe working strength of a leather belt.

c. What is the safe working strength in pounds of a leather belt 4 inches wide and $\frac{1}{4}$ inch thick?

d. A leather belt $\frac{3}{8}$ inch thick has a safe working strength of 675 pounds. What is its width?

e. How thick must a leather belt 8 inches wide be if it is to have a safe working strength of 1200 pounds?

5. The amount of electric current (the number of *amperes*) passing through a circuit may be found by dividing the number of *watts* of electric power used by the number of *volts* of force.

a. Write a formula for this rule, telling the meaning of each letter you use in it.

b. If an appliance uses 550 watts on a 110-volt line, how much current passes through the circuit?

c. A toaster uses 6 amperes (amount of current) and 720 watts. What is the voltage of the line?

d. A motor uses 3 amperes (amount of current) on a 220-volt line. How many watts of power are used?

6. The rate at which an object moves is found by dividing the distance through which it moves by the length of time required.

a. Write a formula for this rule, indicating the meaning of each letter you use in it.

b. If an automobile goes 117 miles in 3 hours, at what rate is it moving?

c. An airplane with an average speed of 300 miles per hour makes a non-stop flight lasting 5 hours. How far does it travel?

d. A bicyclist rides at an average speed of 8 miles per hour. How long does it take him to go 20 miles?

7. The number of feet an automobile travels before coming to a stop after the brakes are applied is .06 times as great as the square of the speed of the automobile in miles per hour.

a. Write a formula for this rule, indicating the meaning of each letter.

b. How many feet does an automobile travel before coming to a stop if it is going 30 miles per hour when the brakes are applied?

8. If a moving automobile strikes an object such as a telephone pole or a fire hydrant, the force of the impact is the same as the force with which it would strike the ground if dropped from a certain height. This height in feet is .0336 times the square of the speed with which the car is moving at the time in miles per hour.

a. Write a formula for this rule, indicating the meaning of each letter.

b. An automobile strikes a solid wall when moving 60 miles per hour. From what height would the car have to be dropped to hit the ground with an equivalent impact?

9. The number of bushels of shelled corn that can be obtained from the corn in a rectangular crib is found by dividing the volume of the crib (in cubic feet) by 2.5. The volume of the crib is the product of its length, width, and height.

a. Write a formula showing how to find the number of bushels of shelled corn obtainable from the corn in a crib.

b. A corn crib is 25 feet long and 6 feet wide. It is filled with corn to a height of 8 feet. How many bushels of shelled corn can be obtained from the corn in it?

Rails are laid with spaces to allow for expansion of the metal when heated. The amount of space is determined by applying a formula.

BLACK STAR

10. The number of tons of coal in a rectangular coal bin is found by taking $\frac{3}{94}$ of the volume of the bin in cubic feet. The volume is the product of the length, width, and height.

a. Write a single formula showing how to calculate the number of tons of coal in a coal bin.

b. A coal bin 8 feet long and 4 feet wide is filled to a height of 6 feet. How many tons of coal does it hold?

A Formula About Right Triangles

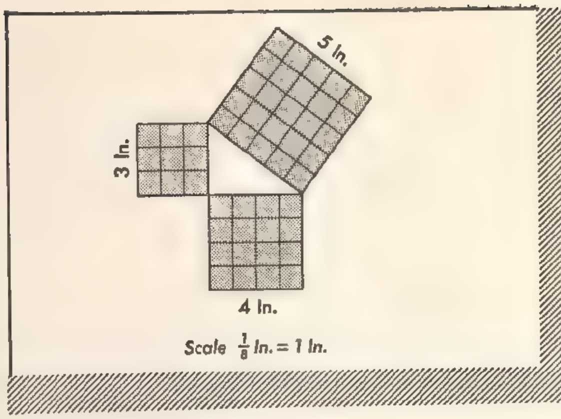


Figure 16–2

For thousands of years, carpenters, surveyors, architects, and draftsmen have used *right triangles* in their work. (A right triangle is a triangle containing an angle of 90 degrees.) One reason right triangles are so useful is this: the length of the long side is always related to the lengths of the other two sides in the same way.

Look at Figure 16–2. It shows a right triangle drawn to scale. One side is 3 inches long; another is 4 inches long; and the third side is 5 inches long. The lower drawing in Figure 16–2 shows a square marked off on each of the three sides. The area of the largest square is 25 square inches; the areas of the other squares are 9 and 16 square inches. The area of the largest square is equal to the sum of the other two areas:

$$25 = 9 + 16.$$

The longest side of a right triangle (the side opposite the right angle) is called the *hypotenuse* (hi-pot′-e-noos). In any right triangle, the square on the hypotenuse equals the sum of the squares on the other two sides. Call the hypotenuse H and the other two sides a and b. Then the square on the hypotenuse is $H \times H$, or H^2; the squares on the other two sides are a^2 and b^2. Now you can write a formula about the sides of a right triangle.

$$\text{Square on the hypotenuse} = \text{square on one side} + \text{square on other side}$$

$$H^2 = a^2 + b^2$$

Carpenters and other craftsmen often use this formula to check their work. A carpenter may need to know whether a triangle he has constructed is really a right triangle. He

measures the sides and finds out whether the square of the hypotenuse is equal to the sum of the squares of the other two sides. If it is, the triangle is a right triangle. If it is not, the triangle is not a right triangle.

Example A triangle has sides 9, 12, and 15 feet in length. Is it a right triangle?

What to Do	How to Do It
(1) Write the formula showing the relation between the hypotenuse and the other two sides of a right triangle.	$H^2 = a^2 + b^2$
(2) Replace the letters by the given values.	$(15)^2 = (9)^2 + (12)^2$
(3) Do the indicated arithmetic.	$15 \times 15 = 9 \times 9 + 12 \times 12$ $225 = 81 + 144$ $225 = 225$ The triangle is a right triangle.

PROBLEMS

Find out whether or not each of the following triangles is a right triangle.

1. A triangle with sides 6 feet, 18 feet, and 20 feet in length.

2. A triangle with sides of 15, 17, and 8 feet.

3. A triangle with sides of 8, 10, and 12 inches.

4. A doubles tennis court is 36 feet by 78 feet. In laying out a court, some boys measured the diagonal to be sure that the corners were right angles. The diagonal measured 85 feet. Were the corners right angles?

5. The foundation of Mr. Carson's new house is to be a rectangle 20 feet by 28 feet. After placing the stakes, Mr. Carson measured the diagonal and found it to be 34 feet. Were the corners right angles?

Finding Square Roots

The formula $H^2 = a^2 + b^2$ is also used to find the length of one side of a right triangle from the lengths of the other two sides. To use it in this way, you must know how to find a *square root.*

Every number has a square root — the number which, when multiplied by itself, gives the original number. For example, the square root of 25 is 5; $5 \times 5 = 25$. "Square root" is shown by a *radical* sign, thus: $\sqrt{25} = 5$.

Sometimes you can determine a square root mentally. Ask yourself what number, when multiplied by itself, gives the value you have. For instance, what number multiplied by itself, gives 144? The answer, of course, is 12.

Example How long is the hypotenuse of a right triangle whose shorter sides are 6 rods and 8 rods, respectively?

What to Do	How to Do It
(1) Write the formula.	$H^2 = a^2 + b^2$
(2) Replace a and b by the given values.	$H^2 = (6)^2 + (8)^2$
(3) Find the value of H^2.	$H^2 = 36 + 64$ $H^2 = 100$
(4) Ask what number, multiplied by itself, gives this value of H^2. The answer is the length of the hypotenuse.	$H \times H = 100$ $10 \times 10 = 100$ $H = 10$ rods Answer

If you have a table of square roots, you may be able to look up the square root of a number. Table 36, page 596, is a table of squares and square roots. Learn to use it by following the directions on the next two pages.

Consider the number 38 as an example. Find 38 in one of the columns headed *Number*. The *square* of 38 is the next number in line with 38, or 1444. The *square root* of 38 is the next number in this line, or 6.164.

$$38 \times 38 = 1444$$

$$6.164 \times 6.164 = 37.994896, \text{ or approximately } 38$$

Table 36. SQUARES AND SQUARE ROOTS OF NUMBERS FROM 1 TO 99

Number	*Square*	*Square Root*	*Number*	*Square*	*Square Root*	*Number*	*Square*	*Square Root*
1	1	1.000	34	1156	5.831	67	4489	8.185
2	4	1.414	35	1225	5.916	68	4624	8.246
3	9	1.732	36	1296	6.000	69	4761	8.307
4	16	2.000	37	1369	6.083	70	4900	8.367
5	25	2.236	38	1444	6.164	71	5041	8.426
6	36	2.449	39	1521	6.245	72	5184	8.485
7	49	2.646	40	1600	6.325	73	5329	8.544
8	64	2.828	41	1681	6.403	74	5476	8.602
9	81	3.000	42	1764	6.481	75	5625	8.660
10	100	3.162	43	1849	6.557	76	5776	8.718
11	121	3.317	44	1936	6.633	77	5929	8.775
12	144	3.464	45	2025	6.708	78	6084	8.832
13	169	3.606	46	2116	6.782	79	6241	8.888
14	196	3.742	47	2209	6.856	80	6400	8.944
15	225	3.873	48	2304	6.928	81	6561	9.000
16	256	4.000	49	2401	7.000	82	6724	9.055
17	289	4.123	50	2500	7.071	83	6889	9.110
18	324	4.243	51	2601	7.141	84	7056	9.165
19	361	4.359	52	2704	7.211	85	7225	9.220
20	400	4.472	53	2809	7.280	86	7396	9.274
21	441	4.583	54	2916	7.348	87	7569	9.327
22	484	4.690	55	3025	7.416	88	7744	9.381
23	529	4.796	56	3136	7.483	89	7921	9.434
24	576	4.899	57	3249	7.550	90	8100	9.487
25	625	5.000	58	3364	7.616	91	8281	9.539
26	676	5.099	59	3481	7.681	92	8464	9.592
27	729	5.196	60	3600	7.746	93	8649	9.644
28	784	5.292	61	3721	7.810	94	8836	9.695
29	841	5.385	62	3844	7.874	95	9025	9.747
30	900	5.477	63	3969	7.937	96	9216	9.798
31	961	5.568	64	4096	8.000	97	9409	9.849
32	1024	5.657	65	4225	8.062	98	9604	9.899
33	1089	5.745	66	4356	8.124	99	9801	9.950

Now take the number 490 as an example. This number is larger than any in the columns headed *Number;* so look for it in the columns headed *Square.* It does not appear; so find the number nearest to it in value. This number is 484. The number at the left of it is 22. Therefore, you know that the square root of 490 is more than 22. So you try numbers between 22 and 23.

$$22.1 \times 22.1 = 488.41$$
$$22.2 \times 22.2 = 492.84$$
$$\sqrt{490} = \text{approximately } 22.1$$

"Junior says his new girl doesn't understand him — but she certainly understands algebra!"

You may want to know a square root when you do not have a table at hand, or you may want to find a square root more exactly than is possible with the table you have. Under such circumstances you will calculate the square root.

To learn how to calculate the square root, study the following example, working it step by step on separate paper. (Notice that the example begins on this page and is continued on page 599.)

Example Calculate the square root of 516, correct to the nearest tenth.

What to Do	How to Do It
(1) Write the number, putting four zeros after the decimal point (that is, twice as many decimal places as you need to round off the answer to tenths). Arrange the figures in groups of two, working both right and left from the decimal point. The "group" farthest to the left may consist of only one figure, but all other groups must contain two figures. Draw a line above the number and put a decimal point directly above the decimal point in the number.	$\overline{5\;16.00\;00}$ (with a decimal point above the line)
(2) Decide what is the largest square contained in the left-hand group of figures. The largest square contained in 5 is 4. Write the square beneath the first group of figures; write its square root above the line. Subtract the square from the first group of figures. Next to the difference write the second group of figures. The resulting number is the *trial dividend.*	2 . $\overline{5\;16.00\;00}$ 4 $\overline{1\;16}$

(3) Multiply the number above the line by 20. The product is the *trial divisor*. Write it next to the trial dividend. Divide it mentally into the trial dividend. The quotient is about 2. Write the quotient above the line, over the second group of figures. Add it mentally to the trial divisor: $40 + 2 = 42$. Multiply this sum by the quotient, and write the result beneath the trial dividend. Subtract and bring down the third group of figures. You now have a new trial dividend.

```
                  2  2.
                  5 16.00 00
                  4
     20 × 2 = 40 | 1 16
              42 |   84
                    32 00
```

(4) Multiply the two-figure number above the line by 20 to get a new trial divisor. Divide it into the new trial dividend. The quotient is about 7. Write the quotient above the line and add it to the trial divisor. Multiply the sum by the quotient, and subtract the result from the new trial dividend. Bring down the fourth group of figures.

```
                  2  2. 7
                  5 16.00 00
                  4
     20 × 2 = 40 | 1 16
              42 |   84
   20 × 22 = 440 |   32 00
             447 |   31 29
                        71 00
```

(5) Find a third trial divisor by multiplying the three-figure number above the line by 20. You can readily see that this trial divisor is contained in the third trial dividend only once; so the quotient is 1. Since the directions called for the square root to the nearest tenth, the calculation may be completed by rounding off 22.71.

```
                  2  2. 7  1
                  5 16.00 00
                  4
     20 × 2 = 40 | 1 16
              42 |   84
   20 × 22 = 440 |   32 00
             447 |   31 29
 20 × 227 = 4540        71 00
```

$\sqrt{516} = 22.7$ Answer

$22.7 \times 22.7 = 515.29$ Check

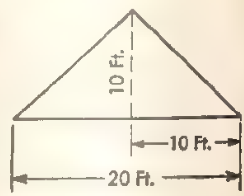
PROBLEMS

Calculate the square roots you need to find in order to solve these problems. Where possible, check your work by using Table 36.

1. A farmer wishes to lay a tile diagonally across a rectangular field whose dimensions are 20 rods and 40 rods. How many rods of tile must he lay?

2. A baseball diamond is a square 90 feet on each side. What is the shortest distance from home to second base?

3. A lot is a rectangle 90 feet by 120 feet. How much shorter is the distance diagonally across the lot than along two sides?



4. The figure at the right shows the front of a gable roof. Each rafter hangs 1 foot over the side walls. Find the length of a rafter.

5. Mr. Robbins wishes to fasten a wire brace to an upright pole. The brace is to be fastened on the pole 12 feet from the ground and anchored 10 feet from the foot of the pole. If he allows two feet of wire for fastening at the ends of the brace, how many feet of wire does he need?

Graphs of Formulas

A formula shows the relation between two or more quantities. If one of these quantities is changed, another one must also be changed. To see what this statement means, consider the formula for the perimeter of a square, $p = 4s$. If you were to draw a half dozen squares, each with a side 1 inch longer than the last, the perimeter of each square would be 4 inches longer than the perimeter of the one before it.

When s is	1″	2″	3″	4″	5″	6″
Then p is	4″	8″	12″	16″	20″	24″

A square may have a side of any length, and when you change the length of a side, the length of the perimeter changes. These lengths, s and p, are called *variables*, because they may

be changed, or varied. But you cannot change the number of sides of a square; a square must have 4 sides. The number 4 is not a variable, but a *constant.*

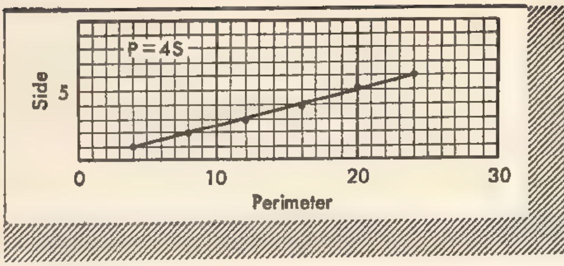


Figure 16–3

You can show the relation between two variables in a formula by making a line graph. Figure 16–3 shows the graph of the formula $p = 4s$.

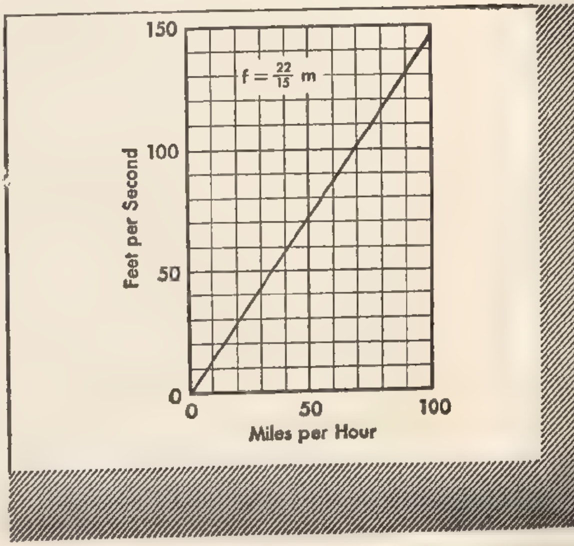
Making and Reading Formula Graphs

A formula graph is made in much the same way as any other line graph (see Chapter 14, pages 498–500). Reference lines are drawn and labelled; points are plotted and joined by lines. As you will find, a formula graph is a smooth-line, rather than a broken-line graph.

To make a line graph of a formula having two variables, select some value for one of the variables. Solve the formula to find out what the value of the other variable is in that case. Then select another value for the first variable. Solve the formula again. Repeat several times. Then label your reference lines, find the points represented by the values of the variables, and draw your graph.

People who have to use the same formula over and over again often make a graph of it. Then they can read the values from the graph, without having to calculate them. For example, Figure 16–4 is a graph of the relation between miles per hour and feet per second; that is, of the formula $f = \frac{22}{15} m$.

Figure 16–4



To change 40 miles per hour to feet per second, locate 40 miles on the horizon-

tal reference line, run your finger up until you come to the graph, then proceed to the left until you come to the vertical reference line. You find that 40 miles per hour equals about 59 feet per second.

To change feet per second to miles per hour, reverse this process.

PROBLEMS

1. Answer the following questions by referring to Figure 16–4, page 601:

a. How many feet per second correspond to 50 miles per hour?

b. If an object is moving at the rate of 100 feet per second, what is its speed in miles per hour?

c. A passenger train is traveling 70 miles an hour. How many feet does it go in one second?

2. Scientists make many measurements in centimeters instead of in inches. A formula for changing inches to centimeters is $c = 2.54\,i$.

a. Draw a line graph showing the relation between centimeters and inches. Select values for c between 1 and 10.

b. About how many inches are there in 8 centimeters?

c. If a scientific report gives a certain dimension as 5 centimeters, what is the length in inches?

3. The total number of hours of sleep needed daily by those under 18 years of age is given by the following formula, in which h stands for hours of sleep and a stands for age in years:

$$h = \frac{34 - a}{2}$$

a. Draw a line graph of the formula.

b. How much sleep is needed by a fourteen-year-old?

c. At what age do children need 15 hours sleep daily?

4. A certain driver customarily averages 35 miles an hour while traveling by automobile. Make a graph showing the relation between the distance he travels and the time he is on the road. Use the formula $d = rt$, substituting the average speed for r.

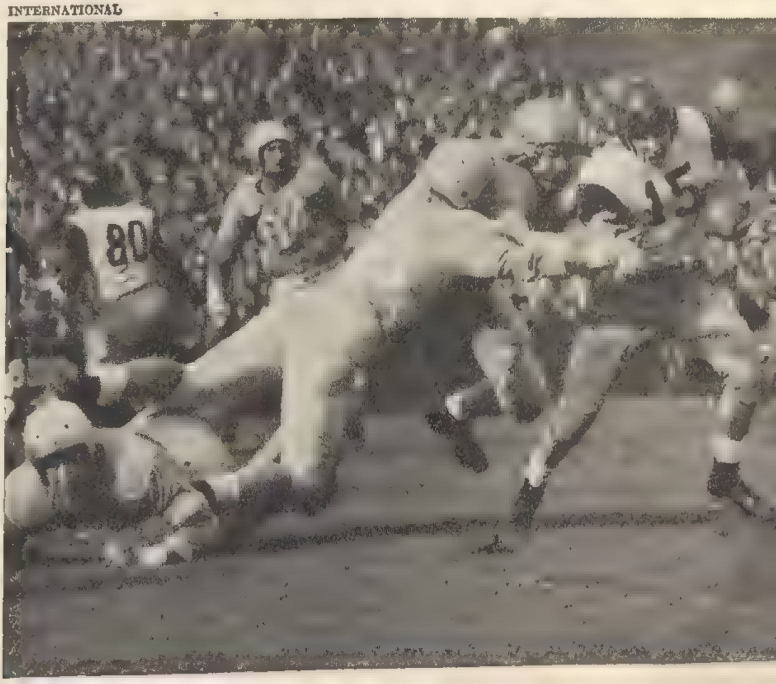
5. A man borrows \$1000 at interest of 8 per cent per year. Make a graph showing how the amount he pays in interest varies with the length of time he has the money. (Use the formula $I = Prt$, substituting the figures in this problem for P and r.)

Numbers Having Direction

The variables in the formulas you have used so far have all had the same direction. But some formulas involve numbers having different directions. Maybe the idea that numbers have direction seems strange to you. It shouldn't, because you have often referred to numbers that have direction. You have surely spoken of being "in the hole" when playing a game, or of being in debt; or you have said that a football player was thrown "for a loss"; or you have remarked that the temperature was below zero.

The direction of numbers is shown by plus and minus signs. Five points "in the hole" may be written -5; five points "to the good" may be written $+5$. A debt of a dollar may be written $-\$1$; a payment of a dollar may be written $+\$1$. A seven-yard loss on a football play may be shown as -7; a seven-yard gain may be shown as $+7$. Six degrees below zero is $-6°$; six degrees above zero is $+6°$. Numbers having

INTERNATIONAL



On this play, the ball carrier was thrown for a three-yard loss. His team made -3 yards.

a plus sign are called *positive* numbers; numbers having a minus sign are called *negative* numbers.

Suppose you started from your home and rode to a friend's house 3 miles north. When you left there, you drove past your house to a store 2 miles south. Then you turned around and drove home. To express this trip in directed numbers, you would show the distance north by plus signs, and the distance south by minus signs. The distance you traveled would be indicated this way:

Home to friend's	+3 miles
Friend's to store:	
Friend's to home	−3 miles
Home to store	−2 miles
Store to home	+2 miles

In all, you traveled ten miles. A negative number does not indicate less than nothing.

PRACTICE

1. When Bob Berry went to bed one night, the thermometer read 18 degrees above zero. When he awoke next morning, it read 5 degrees below zero.

a. Use a directed number to show the temperature at night.
b. Use a directed number to show the temperature the next morning.
c. How many degrees had the temperature dropped?

2. A football team failed to make a first down. On the first play, there was a gain of 3 yards, on the second a loss of 4 yards, on the third a loss of 1 yard, and on the fourth a gain of 7 yards.

a. Show the results of each play, using directed numbers.
b. How much yardage did the team gain before it lost the ball?

3. Stan was "broke"; so he borrowed \$2 from his mother and \$3 from his father. He then got a Saturday job, and earned \$4 each week for three weeks.

a. Represent debts and earnings by directed numbers.

b. How much did Stan have of his earnings after paying his debts?

4. In playing a game, you go 300 points "in the hole."

a. State your score as a directed number.

b. State your score when you are 300 points "to the good."

c. How many points will you have to make before you are 300 points "to the good"?

5. A science class was making a survey of its community to locate trees infested with tent caterpillars. Ted Wheelock chose the avenue on which his house was located, a straight street running east and west. He walked east for one mile, observing the trees on the north side of the street. Then he returned home, observing the trees on the south side of the street. He then got his bicycle, and rode west for three miles, and returned, continuing his observations. Using directed numbers, express each of the following:

a. The distance Ted walked to the east.

b. The distance Ted rode to the west.

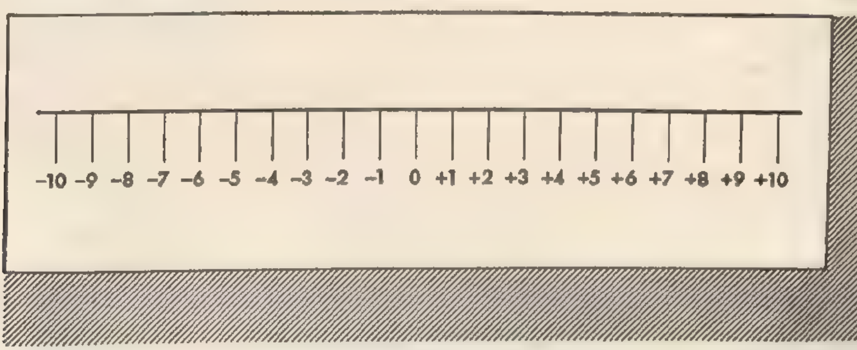
c. The number of miles Ted surveyed while traveling in an easterly direction.

d. The number of miles Ted surveyed while traveling toward the west.

Directed Numbers in Formula Graphs

Zero marks the point where directed numbers begin. There is no such thing as -0 or $+0$; there is only 0. Zero separates positive numbers from negative numbers. Look at Figure 16–5. In it directed numbers are shown as points along a horizontal line, with 0 as the point separating the positive

Figure 16–5



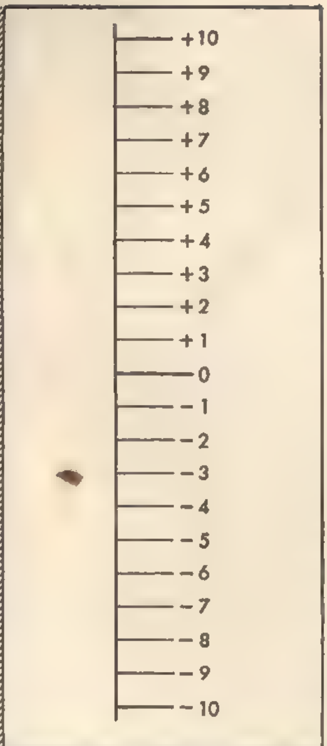


Figure 16-6

numbers from the negative numbers. In Figure 16–6, directed numbers are shown as points along a vertical line. Again 0 is the point separating the opposite numbers.

Figure 16–7 (below) represents a combination of Figures 16–5 and 16–6. On the horizontal line, numbers to the right of the zero point are positive, and numbers to the left of the zero point are negative. On the vertical line, numbers above the zero point are positive, and numbers below the zero point are negative. Figure 16–7 represents the reference lines that are used in graphing formulas with both positive and negative variables.

Such a formula is the one used for changing temperatures measured in Fahrenheit degrees to temperatures measured in centigrade degrees: $F = 1.8\,C + 32$. As you know, in this country temperatures are ordinarily measured on the Fahrenheit thermometer. Wherever metric units are used, however, temperatures are measured on the centigrade thermometer. You can compare the two temperature scales by examining Figure 16–8, which shows a thermometer marked in both ways.

When you study Figure 16–8, you see that zero degrees centigrade (written 0°C) is the same temperature as 32 degrees Fahrenheit (written +32°F). Thirty degrees below zero centigrade (−30°C) is the same temperature as 22 degrees

Figure 16-7

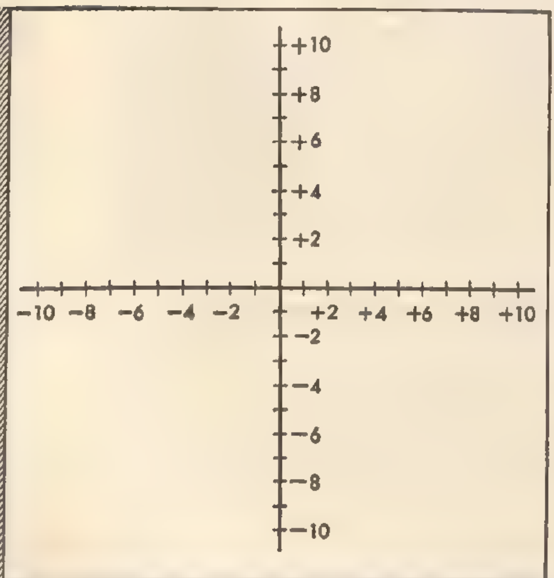
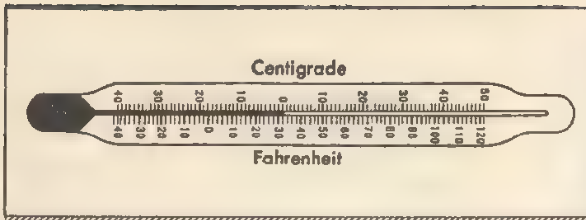


Figure 16–8



below zero Fahrenheit (−22°F). These and other pairs of points are shown here:

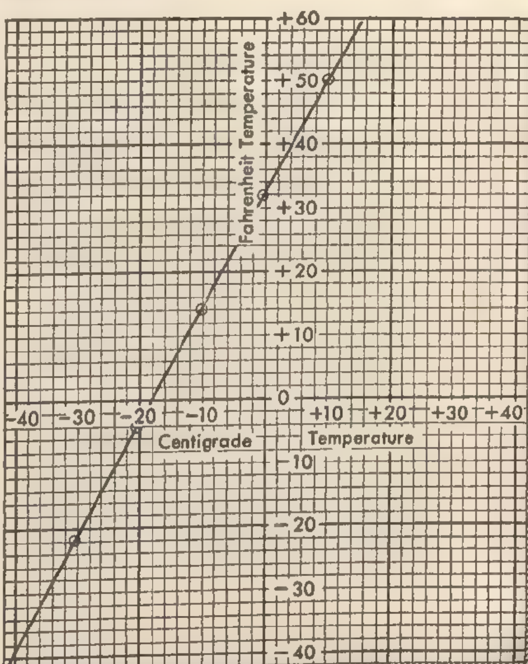
When the reading in °C is	−30	−20	−10	0	+10	+20	+30
Then the reading in °F is	−22	−4	+14	+32	+50	+68	+86

The graph that shows the relationship is pictured in Figure 16–9. The point showing that −20°C = −4°F is 20 points to the left of the zero point and 4 points below the zero point. The point showing that −10°C = +14°F is 10 points left of zero and 14 points above it.

PROBLEMS

Answer the following questions by referring to the graph of the relation between Fahrenheit and centigrade temperatures, Figure 16–9.

Figure 16–9



1. What centigrade temperature is the same as each of the following:

a. +59°F
b. +41°F
c. −13°F
d. 0°F

2. What Fahrenheit temperature is the same as each of the following:

a. −25°C
b. +25°C
c. −5°C
d. 0°C

3. In each case, tell which temperature is the higher:

a. $+5°F$ or $+5°C$ **b.** $-10°C$ or $+10°F$ **c.** $0°C$ or $0°F$

4. In each case, tell which temperature is the lower:

a. $+45°F$ or $+15°C$

b. $+8°F$ or $-8°C$

c. $20°F$ or $20°C$

5. One temperature has the same numerical value whether it is expressed in °F or °C. What temperature is this? (*Hint:* The numerical value is negative.)

Equations Containing Ratios

A *ratio* is an expression showing the relation between two quantities. If Henry earns 50 cents an hour and Robert earns 75 cents an hour, the ratio of Henry's pay to Robert's is $\frac{2}{3}$.

$$\frac{50}{75} = \frac{2}{3}$$

If Jack gets 90 on a test and Mary gets 80, the ratio of Jack's grade to Mary's is $\frac{9}{8}$.

$$\frac{90}{80} = \frac{9}{8}$$

If the Wildcats win 11 games and the Bears win 7, the ratio of the Wildcats' victories to the Bears' victories is $\frac{11}{7}$.

How to Write Ratios

A ratio always indicates a division. The usual way of indicating a division is to write a common fraction. Another way of indicating a division is to write a colon between the quantities being compared. The indicated division $\frac{2}{3}$ may be written 2:3. In either case, it is usually read "2 is to 3" rather than "two-thirds."

A ratio is always a *comparison.* In writing ratios, write the quantity asked about first; then write the quantity with which it is being compared. For example, if you were comparing the cost of a certain leather jacket, L, with the cost of a certain wool plaid jacket, P, you would write $L:P$.

When you write a ratio, express the quantities in the same units. Suppose you were comparing two weights, one

20 ounces and the other 2 pounds. Since there are 16 ounces to a pound, you might write the ratio as $\frac{20}{32}$, which is the same as $\frac{5}{8}$. Or you might express the 20 ounces as $1\frac{1}{4}$ pounds, and write the ratio as $1\frac{1}{4}:2$. Again, $1\frac{1}{4}:2$ is the same as $5:8$, for $\frac{5}{4} \div 2 = \frac{5}{8}$.

Notice that the ratios are written without dimensions or units. It would not be correct to say that the ratio of 20 ounces to 2 pounds is $\frac{20}{32}$ ounces. But it is correct to say that the ratio of 20 ounces to 2 pounds is the same as the ratio of the number 20 to the number 32. A ratio is a relationship between numbers. Usually you use the smallest whole numbers you can. Instead of writing $\frac{20}{32}$ or $20:32$, you would ordinarily write $\frac{5}{8}$ or $5:8$.

GALLOWAY

When the strings of the bass viol vibrate, they produce sound. The tone depends on the number of vibrations per second (the frequency). When two tones are sounded at the same time, the effect is pleasing or displeasing according to the ratio of the frequencies.

PRACTICE

1. In an English test Harriet made a score of 45 and Alice made a score of 36.

a. What is the ratio of Alice's score to Harriet's?

b. What is the ratio of Harriet's score to Alice's?

2. There are 40 students in Miss Jenkins' homeroom. Thirty-five students were present when the attendance was taken on Monday morning.

a. What is the ratio of the students enrolled to the students present?

b. What is the ratio of the students present to the students enrolled?

3. The regular price of a basketball is \$10. At a sale the same basketball is offered for \$7.50. Compare the sale price with the regular price.

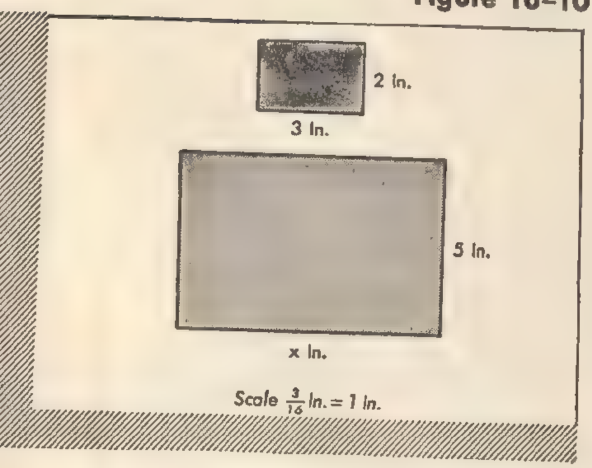
4. Express the ratio of 15 to 40 in each of these ways:

a. As a fraction, without reducing
b. As a fraction, reduced to lowest terms
c. As a fraction, expressed in higher terms
d. Using two dots between the quantities

5. Write each of the following ratios in its lowest terms, either as a fraction or by using the ratio sign.

a. 4 in. to 8 in.
b. 3 ft. to 9 ft.
c. 10 lb. to 12 lb.
d. 8 qt. to 6 qt.
e. 50 min. to 30 min.
f. 10 cents to 25 cents
g. 16 in. to 12 in.
h. 25 lb. to 20 lb.
i. 15 min. to 60 min.
j. 10 qt. to 16 qt.
k. 6 in. to 2 ft.
l. 5 pt. to 5 qt.
m. 3 hr. to 45 min.
n. 1 in. to 10 ft.
o. 1 hr. 45 min. to 35 min.
p. 8 oz. to 3 lb.
q. 4 ft. to 2 yd.
r. 18 ft. to 9 in.
s. 1 lb. 3 oz. to 30 oz.
t. 1 lb. 4 oz. to 46 oz.

Figure 16–10



How to Write and Solve Proportions

A statement that one ratio is equal to another ratio is called a *proportion*. A proportion is a kind of equation, and is solved in the same way other equations are.

Figure 16–10 shows two rectangles having exactly the same shape. According to the dimensions on the drawing, the ratio of the widths is $2:5$. The ratio of the lengths is $3:x$. Because the rectangles have the same shape, the ratio of their widths equals the ratio of their lengths. That is, $2:5 = 3:x$. This proportion is read "2 is to 5 as 3 is to x." In solving it, remember that each ratio is a fraction. Take these steps:

(1) Write the ratios as fractions: $\frac{2}{5} = \frac{3}{x}$

(2) Multiply both members by one of the denominators:
$$5 \times \frac{2}{5} = \frac{3}{x} \times 5$$
$$2 = \frac{15}{x}$$

(3) Multiply both members by the other denominator:
$$x \times 2 = \frac{15}{x} \times x$$
$$2x = 15$$

(4) Complete the solution: $x = 7\frac{1}{2}$ in.

There are many problems that can best be solved by means of proportions. When a problem gives you relationships, you can often set up a proportion.

Example A newspaper advertisement says that a 20-ounce can of cherries holds $2\frac{1}{2}$ cups. How many cups does a 30-ounce can of cherries hold?

What to Do	How to Do It
(1) Decide what the problem asks you to find. Select a letter to stand for this fact.	Amount in a 30-ounce can $= a$
(2) Look for a fact that can be compared to the one you are to find.	Amount in a 20-ounce can $= 2\frac{1}{2}$ cups
(3) Write a proportion showing these relationships.	$30 : 20 = a : 2\frac{1}{2}$ $3 : 2 = a : 2\frac{1}{2}$
(4) Solve the proportion.	$\frac{3}{2} = \frac{a}{2.5}$ $2.5 \times \frac{3}{2} = \frac{a}{2.5} \times 2.5$ $\frac{7.5}{2} = a$ $3.75 = a$ $a = 3\frac{3}{4}$ cups Answer

PROBLEMS

Find the answers to these problems by setting up and solving proportions.

1. A 20-ounce can of tomato juice is sold for 8 cents. At the same rate what would be the cost of a 30-ounce can?

2. Somer's Grocery sells the same kind of orange juice in cans of two different sizes. The smaller can contains 1 lb. 2 oz. of juice and the larger can contains 46 oz. The smaller can sells for 12 cents. At the same rate what would the larger can cost?

3. In 1939, Mrs. Andrews had to pay 30 cents for a dozen eggs. In 1949, she had to pay 81 cents a dozen. What is the ratio of the price she paid in 1949 to the price paid in 1939?

4. In 1939, Miller's Grocery sold 5 pounds of sugar for 26 cents. In 1949, the price was 47 cents for 5 pounds. What is the ratio of the price in 1949 to the price in 1939?

5. A snapshot that measures $2\frac{1}{4}$ inches by $3\frac{1}{4}$ inches is to be enlarged to a width of $6\frac{3}{4}$ inches. Find the length of the enlargement.

6. Robert made a model of a glider. He constructed it to a scale of 1:72. The span of the model (distance from wing tip to wing tip) was $11\frac{7}{8}$ inches. What was the span of the glider itself?

7. A formula for antifreeze solution calls for 7 parts of alcohol to 9 parts of water. How much alcohol is needed if $2\frac{1}{4}$ gallons of water are used?

8. In mixing grass seed for a lawn, Mr. Andrews uses 2 pounds of white clover seed to 5 pounds of bluegrass seed. How much clover seed must he use with 20 pounds of bluegrass seed?

9. On a bar graph, a bar 3 inches long represents 5000 persons. How many persons are represented by a bar $2\frac{1}{4}$ inches long?

10. In typing a composition, Mary found that she had typed 57 words on the first six lines. At that rate how many words could she type on a page containing 28 lines?

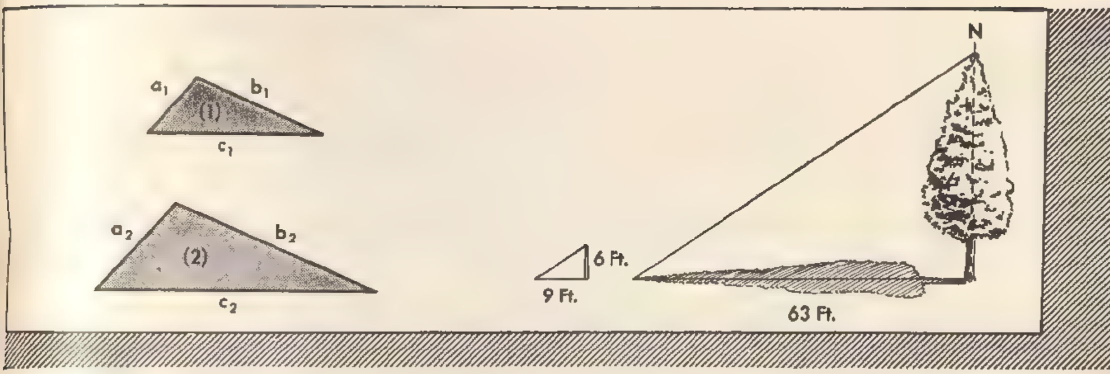


Figure 16–11

Using Proportions to Measure Distances

At the left in Figure 16–11 there are two *similar* triangles. Because the triangles have the same shape, the ratios of the corresponding sides are equal. That is:

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}.$$

Proportions such as these can be used to find distances that are difficult or impossible to measure directly. At the right in Figure 16–11 are pictured a post and its shadow, and a tree and its shadow. It is not difficult to measure the height of the post and the lengths of the shadows. From these measurements the height of the tree can be calculated.

Example Find the height of the tree in Figure 16–11. The tree's shadow is 63 feet long. The pole is 6 feet in height and casts a shadow 9 feet long.

What to Do	How to Do It
(1) Write the proportion stating that the height of the tree is to the height of the pole as the length of the tree's shadow is to the length of the pole's shadow.	$\frac{T}{6} = \frac{63}{9}$
(2) Solve the proportion.	$6 \times \frac{T}{6} = \frac{63}{9} \times 6$ $T = 42$ ft. Answer

FREDERIC LEWIS

Surveyers, such as those shown here, use ratios and proportions in measuring distances.

PROBLEMS

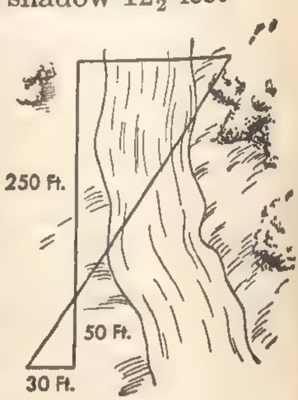
1. A telegraph pole casts a shadow 56 feet long. At the same time, a yard stick held vertically casts a shadow 4 feet long. What is the height of the telegraph pole?

2. A man, 6 feet tall, casts a shadow 10 feet long. How high is a tree which, at the same time, casts a shadow 75 feet long?

3. A building casts a shadow 95 feet long. At the same time, a pole 7 feet high casts a shadow $9\frac{1}{2}$ feet long. How high is the building?

4. A monument casts a shadow 75 feet long. At the same time, a near-by flag pole 10 feet high casts a shadow $12\frac{1}{2}$ feet long. How high is the monument?

5. To measure the distance across a river without crossing the river, a surveyor marked off similar triangles as shown in the drawing. He measured the lengths of two corresponding sides and found them to be 50 feet and 250 feet. Then he measured the length of the side of the smaller triangle which corresponded to the width of the river. The measurement was 30 feet. How wide was the river?



What You Have Learned in This Chapter

1. To use a letter to mean "a certain quantity"
2. To use letters in addition, subtraction, multiplication, and division
3. To read statements containing letters
4. To form equations from statements in words
5. To solve equations
6. To use proportions in solving problems
7. To make formulas from rules
8. To apply formulas
9. To find square roots
10. To make line graphs of formulas
11. To read values from graphs of formulas
12. To use directed numbers
13. To write ratios and proportions
14. To solve proportions
15. To use the following terms correctly: *equation, formula, hypotenuse, square root, positive number, negative number, ratio, proportion*

Review Test on Algebra

1. Using letters as numbers, express the following:

a. A certain number to which 420 is added.
b. Eight less than a certain number.
c. A certain number multiplied by seven.
d. A certain number divided by three.
e. A certain number multiplied by itself (squared).

2. Write an equation expressing each of the following:

a. Three times a number increased by four is twenty-two.
b. Five times a number decreased by three is thirty-seven.
c. One third a number equals seven.

d. The sum of two numbers is 25. The larger number is 3 more than the smaller number.

e. The sum of two numbers is 45. One of the numbers is 5 times the other.

3. Solve each of these equations:

a. $x - 17 = 27$	**f.** $1.9 = b - .3$
b. $y + 3 = 16$	**g.** $3.5 + a = 7.8$
c. $\frac{z}{6} = 14$	**h.** $21 = 6m + 9$
d. $12n = 300$	**i.** $\frac{1}{2}x - 3 = 5$
e. $\frac{22p}{7} = 121$	**j.** $\frac{3}{4}d + 8 = 14$

4. Harry wishes to cut a piece of wire 36 inches long into two pieces so that one piece is twice as long as the other. By using an equation, find how long the shorter piece should be.

5. A baseball player's batting average is determined by dividing the number of hits he makes by the number of times he is at bat.

a. Select a letter to stand for each value. Tell the meaning of each letter you select. Write a formula which can be used to calculate batting averages.

b. A certain National League player was at bat 589 times one season, and made 175 hits. Express his batting average as a three-place decimal.

c. In a recent year, a player in the Pacific Coast League, who was at bat 696 times, had a batting average of .341. How many hits did he make? (Give the nearest whole number.)

d. During a recent World Series, one of the American League players had a Series batting average of .323. He made 10 hits. How many times was he at bat? (Give the nearest whole number.)

6. The relationship between height in inches and average weight in pounds of American adults may be found by using this formula:

$$w = 5.5\,h - 220$$

a. Draw a line graph of the formula.

b. What is the average of the weights of American adults whose height is 5 feet 5 inches?

c. What is the average height of American adults weighing 110 pounds?

7. Mrs. Atwell's home is on a highway running north and south. One day, she drove her children to the school 2 miles north of their home; after leaving them, she turned around and drove south to a farm store 3 miles from her home. After making some purchases, she returned home.

a. Using directed numbers, express the distance Mrs. Atwell drove in a northerly direction.

b. Using a directed number, express the distance she drove in a southerly direction.

c. How many miles did she travel on the errands described?

8. The regular price of a radio is \$120. At a sale, it is offered for \$96.

a. What is the ratio of the regular price to the sale price?

b. What is the ratio of the sale price to the regular price?

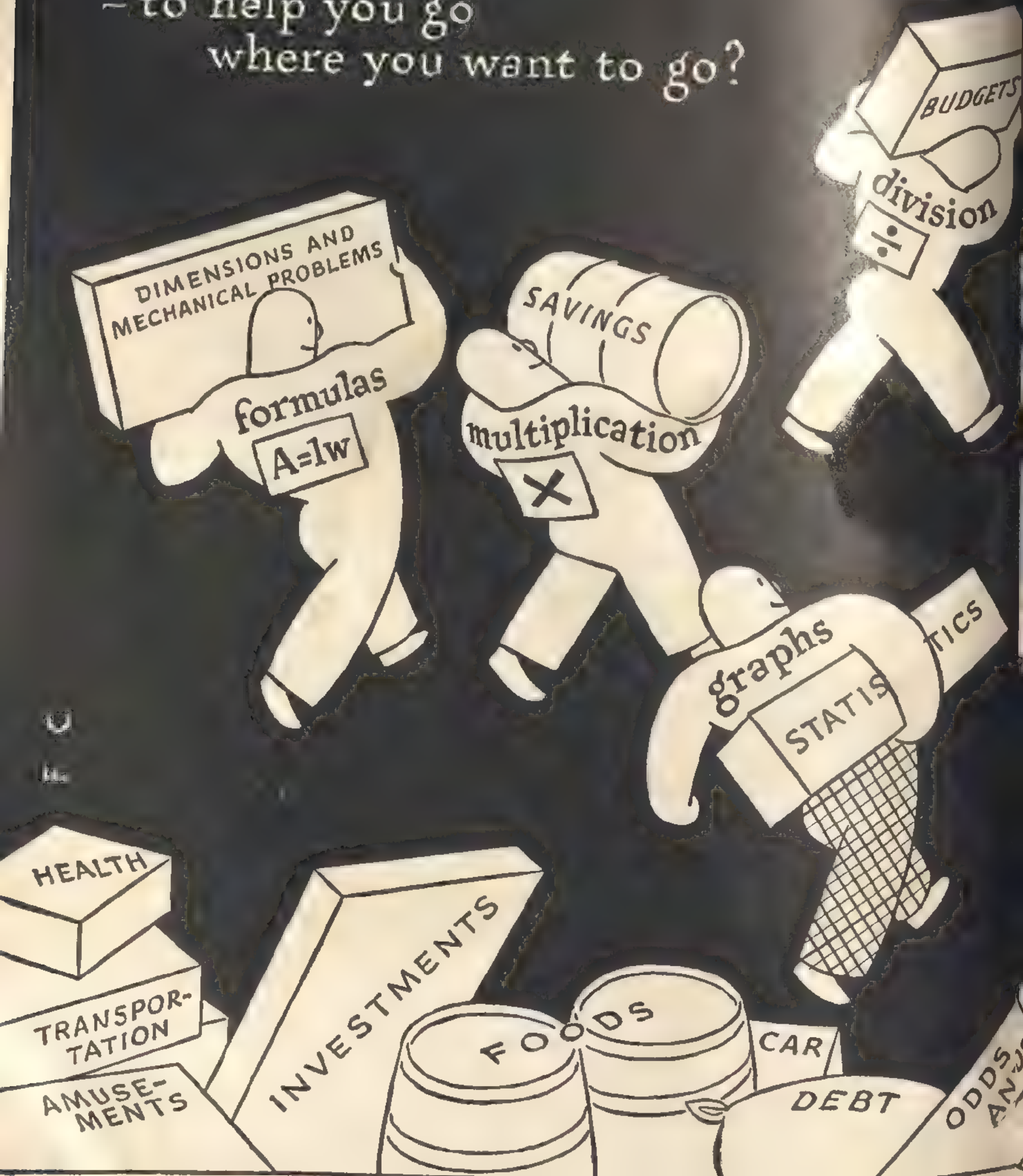
9. A can of fruit juice that weighs 20 ounces contains $2\frac{1}{2}$ cups of juice. By using a proportion, find the number of cups of juice in a can that weighs 28 ounces.

10. Richard is 5 feet 6 inches tall. When the length of his shadow was 4 feet 6 inches, the shadow of a flagpole was 55 feet long. How high is the flagpole?

How do you rate?	Excellent	Good	Fair	Poor
	9–10	7–8	5–6	4 or less

Can you use mathematics—

– to work for you?
– to help you get
 the things you want?
– to help you go
 where you want to go?




ACCOUNTS
EARNINGS
addition
+
NTEREST
per cent
%
VALUES
equations
=
EXPENSES
subtraction
−
GIFTS
BOOKS
INSURANCE
TAXES
ESTIMATES
HOME
CLOTHES

Final Tests on Computation

These tests are matched with those following Units Two, Three, and Four. You should be able to do all the items accurately and quickly.

TEST ON WHOLE NUMBERS

Find these sums:

1)	2)	3)	4)	5)
805	261	82	28	50
39	73	275	119	84
914	70	381	747	169
43	387	94	38	498
803	469	570	136	358

6)	7)	8)	9)
61	93	39	240
386	451	195	97
70	192	58	569
405	65	509	16
469	681	247	358

10)	11)	12)	13)	14)
926	38	604	15	27
931	106	53	842	717
925	47	103	7014	4036
50	610	772	60	21
14	136	92	801	20
			3	5

15)	16)
27	704
820	5040
6036	703
49	54
25	92

17)	18)	19)	20)
16	382	93	39
28	262	364	208
925	581	292	658
832	76	83	227
914	70	681	47

Find these differences:

21) 87413
57184

22) 98525
69170

23) 94053
20156

24) 35690
19073

25) 47305
46295

26) 80403
46335

27) 61894
18327

28) 73422
66938

29) 37260
25182

30) 90961
14527

31) 73950
47031

32) 361957
80829

33) 85302
40579

34) 74069
18476

35) 87521
39845

36) 214818
56298

37) 458650
30470

38) 63284
20689

39) 627185
35206

40) 307279
73419

Find these products:

41) 2671
70

42) 120
42

43) 746
83

44) 9301
38

45) 78
24

46) 92
95

47) 17
59

48) 45
59

49) 26
16

50) 70
61

51) 48
16

52) 53
24

53) 38
59

54) 35
61

55) 60
95

56) 91
61

57) 825
38

58) 804
70

59) 649
24

60) 935
70

Find the following quotients:

61) $39\overline{)1872}$

62) $80\overline{)207760}$

63) $92\overline{)6533}$

64) $14\overline{)406}$

65) $41\overline{)3588}$

66) $65\overline{)58697}$

67) $56\overline{)45472}$

68) $65\overline{)4940}$

69) $93\overline{)5769}$

70) $80\overline{)61240}$

71) $14\overline{)560}$

72) $41\overline{)1276}$

73) $56\overline{)2520}$

74) $80\overline{)33280}$

75) $14\overline{)922}$

76) $72\overline{)40638}$

77) $27\overline{)2781}$

78) $39\overline{)2308}$

79) $27\overline{)266544}$

80) $32\overline{)1209}$

How do you rate?	Excellent	Good	Fair	Poor
	80	78–79	75–77	74 or less

TEST ON COMMON FRACTIONS

Give each sum in its lowest terms:

1) $\frac{2}{5} + \frac{1}{5}$

2) $\frac{1}{4} + \frac{1}{4}$

3) $\frac{1}{12} + \frac{7}{12}$

4) $\frac{2}{3} + \frac{1}{3}$

5) $\frac{3}{8} + \frac{7}{8}$

6) $\frac{7}{16} + \frac{11}{16}$

7) $2\frac{1}{6} + 5\frac{1}{6}$

8) $6\frac{5}{12} + 7\frac{1}{12}$

9) $\begin{array}{r} 6\frac{7}{8} \\ \underline{3} \end{array}$

10) $\begin{array}{r} \frac{3}{8} \\ \underline{\frac{3}{4}} \end{array}$

11) $\begin{array}{r} \frac{1}{2} \\ \underline{\frac{5}{16}} \end{array}$

12) $\begin{array}{r} \frac{11}{12} \\ \underline{\frac{5}{6}} \end{array}$

13) $\begin{array}{r} 15\frac{13}{16} \\ \underline{6\frac{3}{4}} \end{array}$

14) $\begin{array}{r} 2\frac{3}{5} \\ \underline{7\frac{7}{10}} \end{array}$

15) $\begin{array}{r} \frac{3}{5} \\ \underline{\frac{1}{3}} \end{array}$

16) $\begin{array}{r} \frac{5}{6} \\ \underline{\frac{3}{4}} \end{array}$

17) $\begin{array}{r} 5\frac{1}{5} \\ \underline{11\frac{3}{4}} \end{array}$

18) $\begin{array}{r} 12\frac{1}{2} \\ \underline{8\frac{2}{3}} \end{array}$

19) $\begin{array}{r} 17\frac{2}{5} \\ \underline{9\frac{5}{8}} \end{array}$

20) $\begin{array}{r} 14\frac{1}{6} \\ \underline{2\frac{5}{16}} \end{array}$

Give each difference in its lowest terms:

21) $\frac{4}{5} - \frac{1}{5}$

22) $\frac{5}{16} - \frac{1}{16}$

23) $\frac{7}{10} - \frac{3}{10}$

24) $7\frac{3}{4} - 3\frac{1}{4}$

25) $12\frac{5}{6} - 7\frac{1}{6}$

26) $18\frac{7}{8} - 13$

27) $9\frac{3}{5} - \frac{1}{5}$

28) $15 - \frac{1}{5}$

29) $\begin{array}{r} 10 \\ \underline{6\frac{1}{3}} \end{array}$

30) $\begin{array}{r} 12\frac{3}{4} \\ \underline{7\frac{1}{4}} \end{array}$

31) $\begin{array}{r} 19\frac{1}{5} \\ \underline{9\frac{3}{5}} \end{array}$

32) $\begin{array}{r} \frac{5}{6} \\ \underline{\frac{1}{3}} \end{array}$

33) $\begin{array}{r} \frac{7}{10} \\ \underline{\frac{3}{5}} \end{array}$

34) $\begin{array}{r} 15\frac{3}{4} \\ \underline{7\frac{1}{2}} \end{array}$

35) $\begin{array}{r} 22\frac{2}{3} \\ \underline{19\frac{5}{6}} \end{array}$

36) $\begin{array}{r} 14\frac{5}{12} \\ \underline{8\frac{1}{2}} \end{array}$

37) $\begin{array}{r} 11\frac{2}{3} \\ \underline{4\frac{3}{4}} \end{array}$

38) $\begin{array}{r} 26\frac{1}{8} \\ \underline{19\frac{3}{5}} \end{array}$

39) $\begin{array}{r} 15\frac{3}{5} \\ \underline{13\frac{5}{6}} \end{array}$

40) $\begin{array}{r} 16\frac{1}{10} \\ \underline{14\frac{1}{5}} \end{array}$

Give each product in its lowest terms:

41) $\frac{1}{6}$ of 78

42) $\frac{1}{4}$ of \$3.60

43) $\frac{1}{3}$ of 168

44) $\frac{3}{4}$ of 52

45) $\frac{2}{5}$ of 6

46) $\frac{3}{4}$ of 62

47) $32 \times \frac{3}{5}$

48) $\frac{7}{8} \times \frac{3}{5}$

49) $\frac{5}{6} \times \frac{2}{5}$

50) $\frac{7}{10} \times \frac{2}{3}$

51) $28 \times 1\frac{1}{6}$

52) $300 \times 4\frac{2}{5}$

53) $2\frac{1}{3} \times \frac{1}{3}$

54) $4\frac{3}{8} \times 4$

55) $16\frac{3}{5} \times 45$

56) $5\frac{1}{3} \times 2\frac{1}{4}$ 57) $7\frac{2}{5} \times 8\frac{1}{5}$ 58) $3\frac{3}{8} \times 7\frac{1}{6}$

59) $3\frac{1}{3} \times 7\frac{2}{5} \times \frac{3}{10}$ 60) $3\frac{2}{3} \times 5\frac{1}{4} \times 1\frac{5}{6}$

Give each quotient in its lowest terms:

61) $3 \div \frac{1}{6}$

62) $6 \div \frac{5}{8}$

63) $8 \div \frac{2}{3}$

64) $\frac{1}{8} \div \frac{1}{8}$

65) $\frac{1}{3} \div \frac{1}{8}$

66) $\frac{3}{16} \div \frac{3}{4}$

67) $\frac{2}{5} \div \frac{5}{8}$

68) $\frac{3}{4} \div 15$

69) $\frac{2}{3} \div 30$

70) $\frac{1}{4} \div 16$

71) $4\frac{4}{5} \div 3$

72) $3\frac{3}{4} \div \frac{5}{6}$

73) $9\frac{1}{8} \div 4$

74) $30 \div 1\frac{1}{5}$

75) $\frac{7}{12} \div 4\frac{2}{3}$

76) $4 \div 2\frac{3}{5}$

77) $\frac{4}{5} \div 5\frac{1}{3}$

78) $7\frac{1}{3} \div 3\frac{2}{5}$

79) $2\frac{3}{4} \div 6\frac{1}{6}$

80) $6\frac{5}{6} \div 4\frac{5}{8}$

How do you rate?	Excellent	Good	Fair	Poor
	80	78–79	75–77	74 or less

TEST ON DECIMAL FRACTIONS

Add each of the following groups of decimal fractions:

1) .4, .1, .3
2) .9, .3, .8
3) .16, .13, .25
4) .28, .37, .29
5) .04, .44, .36
6) .45, .69, .53, .62
7) .26, .70, .84, .40
8) .86, .57, .95, .78
9) .379, .045, .008
10) .426, .643, .576
11) 4.6, 2.5, 5.3
12) 5.2, 7.8, 9.5
13) 6.34, .57, 8.36
14) 8.97, 4.75, 69.47
15) 8, 5.6, 8.3
16) 9.4, 7.2, 8.3

17) 96.45, 7.67, 74.32

18) 13, .09, 54.73

19) 8.952, .856, 7.069

20) .503, 7.893, .876

Subtract the smaller number from the larger in each pair of numbers:

21) .4, .5

22) .43, .67

23) .45, .44

24) .67, .76

25) .67, .58

26) 3.8, 7.5

27) 25.5, 7.5

28) 57.48, 39.29

29) 8.7, 6

30) 7, 9.6

31) 58, 79.6

32) 3.4, 36

33) 6, .05

34) 7.045, 7.405

35) 45, 40.45

36) 300, 28.25

37) 32.5, 40

38) .06, .073

39) .0409, .0490

40) 4.387, .476

Multiply:

41) $\begin{array}{r} .5 \\ \underline{2} \end{array}$ 42) $\begin{array}{r} 38 \\ \underline{.3} \end{array}$ 43) $\begin{array}{r} .14 \\ \underline{5} \end{array}$ 44) $\begin{array}{r} 56 \\ \underline{.34} \end{array}$ 45) $\begin{array}{r} .453 \\ \underline{5} \end{array}$

46) $\begin{array}{r} 635 \\ \underline{.007} \end{array}$ 47) $\begin{array}{r} .4 \\ \underline{.9} \end{array}$ 48) $\begin{array}{r} .62 \\ \underline{.5} \end{array}$ 49) $\begin{array}{r} .04 \\ \underline{.6} \end{array}$

50) $\begin{array}{r} .57 \\ \underline{.6} \end{array}$ 51) $\begin{array}{r} .04 \\ \underline{.09} \end{array}$ 52) $\begin{array}{r} 3.6 \\ \underline{4.8} \end{array}$ 53) $\begin{array}{r} .94 \\ \underline{6.8} \end{array}$

54) $\begin{array}{r} 370 \\ \underline{.04} \end{array}$ 55) $\begin{array}{r} 620 \\ \underline{.026} \end{array}$ 56) $\begin{array}{r} .057 \\ \underline{640} \end{array}$

57) $\begin{array}{r} 308.9 \\ \underline{.23} \end{array}$ 58) $\begin{array}{r} 4.58 \\ \underline{7.9} \end{array}$ 59) $\begin{array}{r} 28.45 \\ \underline{.35} \end{array}$ 60) $\begin{array}{r} 746.80 \\ \underline{.75} \end{array}$

Divide:

61) $3\overline{).9}$

62) $7\overline{).21}$

63) $8\overline{).064}$

64) $7\overline{)1.26}$

65) $34\overline{).748}$

66) $17\overline{)7.14}$

67) $47\overline{)357.2}$

68) $26\overline{)1.56}$

69) $4\overline{)3}$

70) $23\overline{)16}$

71) $10\overline{)4.8}$

72) $100\overline{)5.9}$

73) $1000\overline{)85.2}$

74) $.6\overline{)96}$

75) $.04\overline{).292}$

76) $3.9\overline{)10.92}$

77) $13.7\overline{)57.54}$

78) $37.5\overline{)60}$

79) $2.6\overline{)18.74}$

80) $6.08\overline{)54.32}$

How do you rate?	Excellent	Good	Fair	Poor
	80	78–79	75–77	74 or less

TEST ON PER CENTS

1) Find 5% of 450.
2) \$1.80 is what per cent of \$3.00?
3) 3.5% of 240 = ?
4) Find 4.5% of 240.
5) How much is 95% of 400?
6) \$1600 is what per cent of \$40,000?
7) 28 is 70% of what number?
8) How much is 55% of 600?
9) What per cent of 32 is 24?
10) 30 is what per cent of 24?
11) $12\frac{1}{2}$% of 24 = ?
12) 250% of what number is equal to 195?
13) 4.08% of 264 = ?
14) .3 is what per cent of 50?
15) 15 is what per cent less than 60?
16) 18 is 60% less than what amount?
17) 384 is 20 per cent more than what amount?
18) 70 is what per cent increase over 56?
19) \$31.50 is 25% less than what amount?
20) 4302.4 is .5 per cent more than what amount?

How do you rate?	Excellent	Good	Fair	Poor
	20	18–19	16–17	15 or less

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